**Technical Report 1256**

# Leader and Team Adaptation: The Influence and Development of Key Attributes and Processes

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This report summarizes the results of a series of investigations that examined (a) the role of feedback processes as a leadership tool in team adaptation, (b) the influence of developmental work experiences on team and leader adaptability, and (c) the effects of combinations of leader qualities on the display of adaptation processes and performance in dynamic military and business settings. The results of these investigations indicated that (a) process-oriented, team level, and public feedback from leaders was most effective in facilitating team adaptation, particularly when team members possess high levels of cognitive skills; (b) developmental assignments are associated with growth in social competencies, but only when participating leaders have high levels of metacognitive skill, cognitive complexity, and tolerance for ambiguity; (c) social competencies influence leader adaptability, but only when the organizational climate supports innovation; and (d) several cognitive, social, and dispositional leader attributes were related singly and in combination to leader adaptability.

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LEADER AND TEAM ADAPTATION: THE INFLUENCE AND DEVELOPMENT OF KEY ATTRIBUTES AND PROCESSES

## EXECUTIVE SUMMARY


Research Requirement:

This report summarizes the results of a series of investigations that examined (a) the role of feedback processes as a leadership tool in team adaptation, (b) the influence of developmental work experiences on team and leader adaptability, and (c) the effects of combinations of leader qualities on the display of adaptation processes and performance in dynamic military and business settings.

Procedure:

Investigation 1 examined the hypothesis that team-level process-oriented feedback as a form of leadership communication would facilitate team adaptation more so than individual-level process-oriented feedback or outcome-only feedback. The sample for this effort included 186 undergraduate students who completed a computer-based military simulation game.

Investigation 2 examined the hypothesis that the public versus private administration of leader feedback would moderate the effects of feedback on the development of team mental models and team adaptation, such that feedback effects would be stronger in public administrations. The sample for this effort included 171 undergraduates who completed the same computer simulation as in Investigation 1.

Investigation 3 tested the hypothesis that the joint effects of practice scenario variability and feedback would promote team adaptation. The sample for this effort included 198 undergraduates.

Investigations 4 and 5 examined the hypothesis that developmental work experiences would foster the adaptability attributes of tacit knowledge and social capabilities, but these effects would be stronger in leaders with particular cognitive and dispositional attributes. The participants included 150 military and civilian leaders (O5s, O6s, GS 14s and 15s) in Investigation 4, and 72 comparable leaders in Investigation 5.

Investigation 6 examined the hypothesis that developmental assignments would foster social competencies, and that this adaptability attribute would predict ratings of adaptive performance. The effects of assignments on attributes were proposed to be enhanced by leader cognitive and dispositional attributes, while the effects of adaptability attributes on adaptation would be enhanced by organizational support for innovation. The sample for this research included 120 business managers at lower, middle, and upper organizational levels.

Investigations 7 and 8 examined the hypothesis that cognitive, social, and dispositional attributes of the leader would act jointly to influence the display of leader adaptation in a

business role play (Investigation 7) and a military simulation task (Investigation 8). The samples for these efforts were 142 upper and middle level managers (Investigation 7) and 572 military officers (Investigation 8).

Findings:

Overall, the findings of each research effort provided reasonable support for the proposed hypotheses. In investigation 1, which examined team-level process-oriented feedback as a form of leadership communication, the joint effects of feedback level and content were found to be even stronger in teams that possessed higher levels of aggregated metacognitive skills.

In investigation 2, which examined the public versus private administration of leader feedback, the feedback effects on team adaptation were shown to occur primarily through their effects on shared mental models.

In investigation 3, which examined the joint effects of practice scenario variability and feedback, variability marginally increased adaptation when feedback was provided. This result suggests a need for future research to examine more closely the effects of variability on adaptation. Other results from this investigation indicated that teams receiving feedback also were found to engage in more effective team processes and displayed higher collective efficacy and better quality team mental models than teams that did not receive feedback. Training variability reduced collective efficacy and team mental model quality.

In investigations 4 and 5, which examined developmental work experiences, adaptability characteristics were cultivated but more so in leaders with particular cognitive and behavioral traits.

In investigation 6, which examined the impact of developmental assignments on social competencies, leader cognitive and dispositional attributes enhanced the effect of such assignments while social competence was promoted by organizational support.

In investigations 7 and 8, which examined the impact of cognitive, social, and dispositional attributes of the leader on adaptation, such characteristics moderately influenced leader adaptation in a role play and military simulation task.

Zaccaro (2001) argued that research efforts on leadership should focus on five sets of leadership constructs, and provide evidence for the validated linkages among the variables across these sets. These leadership construct sets were: (a) the nature of leadership performance, (b) the leadership processes contributing to performance, (c) the attributes and characteristics of leaders that promote the effective display of leadership processes, (d) leader training and development principles that foster growth in these attributes and characteristics, and (e) assessment and selection strategies based on these attributes. Taken together, the investigations in this research effort provide data and results pertinent to each of these construct sets.

Utilization and Dissemination of Findings:

Leader adaptability and effectiveness in unconventional and rapidly changing battlefield conditions has become a paramount concern for the U.S. Army. Such concern has translated to a need for more in-depth and comprehensive investigations of the leadership attributes and processes that facilitate adaptation, as well as the best means of developing these attributes. The research efforts described in this report provide findings that touch on several key issues in leadership and adaptability. These findings should serve as a foundation for future research on developing adaptability skills.

LEADER AND TEAM ADAPTATION: THE INFLUENCE AND DEVELOPMENT OF KEY ATTRIBUTES AND PROCESSES

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# Introduction

## *Background and Research Needs*

Adaptability represents a defining characteristic of military leader and team effectiveness. Today's Soldiers need to operate in ambiguous and highly dynamic environments, with higher information loads and shorter time frames for decision-making and action. They also may be required to engage in multiple kinds of operations, often entwined within the same overall mission. For example, in Iraq and Afghanistan, Soldiers have had to conduct war fighting, peace making, peacekeeping, and stability and support activities in meeting their mission goals. Such multi-dimensional military operations require Soldiers and officers to switch rapidly across different roles. Also, most of the war fighting and peacemaking/keeping operations have occurred in dense urban terrains, a particularly stressful and aversive environment. These qualities of military operations indicate that leadership and team effectiveness will rest on leaders and team members possessing the capabilities contributing to successful adaptability.

These observations suggest several important directions for military research. First, we need to understand more about the nature of adaptive performance. Pulakos, Arad, Donovan, and Plamondon (2000) noted that "adaptability, flexibility, and versatility are elusive concepts that have not been well defined in the psychological literature and therefore difficult to measure, predict, and teach effectively" (p. 612). In response, Pulakos et al. developed a classification, and a corresponding measure, that specified eight dimensions of adaptive performance. In 2002, Pulakos, Schmitt, Dorsey, Arad, Hedge, and Borman provided evidence supporting their taxonomy and tied their dimensions to several predictors. Their research program has provided a valuable foundation to examine the nature and determinants of effective individual and team adaptability.

Additional research, however, needs to focus on the leadership and team processes that contribute to effective adaptive performance. Leaders solve organizational problems by engaging in processes such as information acquisition, solution generation and evaluation, solution planning and implementation, and problem monitoring (Mumford, Zaccaro, Harding, Jacobs, & Fleishman, 2000). How these processes change and evolve within dynamic organizational contexts remains a largely unanswered question. For example, in rapidly changing situations, scanning and other information acquisition activities may involve a relatively greater focus on recognizing what patterns are changing in the operating environment and what such changes mean for the leader's unit. Also, because leaders need to inform team members of changing circumstances, sense-giving processes may become more important as well (Marks, Zaccaro, & Mathieu, 2000; Burke, 1999). Likewise managing teams in such contexts may require more persuasion processes on the part of the leader to convince team members to alter established routines in the face of change (cf. Kotter, 1996). Understanding Soldier adaptability, then, requires greater knowledge of how leadership processes change to foster team adaptability in dynamic environments.

A second direction for research concerns the identification of leader attributes that contribute particularly to effective adaptability. Zaccaro (2001) specified sets of cognitive and social capabilities, as well as dispositional tendencies, that are linked to leader effectiveness. Flexibility represented a common theme across these sets. For example, cognitive complexity

represents the ability to construct highly differentiated and integrated mental representations (Streufert & Swezey, 1986). However, Streufert and Swezey also defined *flexible integrative complexity:* an ability to create dynamic and fluid relationships among conceptual elements that vary according to changes in environmental stimuli. Such ability should contribute particularly to leader effectiveness in a fluid and complex environment. Zaccaro, Gilbert, Thor, and Mumford (1991) argued that behavioral flexibility also represented a critical leader attribute. Organizational situations vary in their performance requirements for leaders. Accordingly, leaders need to be able to discern what responses are necessary in particular situations and respond accordingly. Finally, flexibility as a dispositional tendency contributes to leader adaptability. Effective leaders display openness and tolerance in the face of social uncertainty and ambiguity.

Zaccaro (2001; see also Zaccaro, Kemp, & Bader, 2004) also argued that effective and adaptive leadership emerged from an *integrated* constellation of cognitive, social, and dispositional qualities. This approach, also called the "pattern approach" (Smith & Foti, 1998), represents a deviation from most leader trait perspectives that emphasize univariate or additive models of leader attributes and performance. Pattern approaches to leader attributes argue that the traits and attributes of leadership should not be considered in relative isolation in terms of their influences on leader effectiveness. Instead researchers should explore how different combinations of attributes add incremental variance to the explanation of leadership outcomes. For example, Zaccaro argued that executive effectiveness more likely emerged from a combination of the leaders' ability to think in flexible and complex ways about problems, and their behavioral flexibility and skill to implement solutions in complex social domains, as well as their predisposition to remain open—and indeed feel fairly comfortable—in ambiguous and complex operating environments. Further, the contribution of each attribute depends upon the level of other attributes. For example, a leader with high cognitive skills will not be effective without corresponding social or behavioral skills. Likewise, a disposition for openness and tolerance for ambiguity should establish the foundation for both cognitive and behavioral flexibility (Zaccaro, 2001).

The leader attributes that contribute to effective adaptability need to be considered as integrated patterns influencing leader performance. However, research on such integrated leader attribute patterns has been minimal, particularly in military settings. Those studies that utilized multivariate approaches to leader attributes (e.g., Connelly, Gilbert, Zaccaro, Threlfall, Marks, & Mumford, 2000) did not consider sufficiently how particular qualities acted jointly to influence leadership, or how some attributes moderated the effects of others on leadership. Understanding leader adaptability and the leader traits that contribute to effectiveness in dynamic environments requires such an approach.

Another research direction for the military concerns the identification of effective leader and team training design parameters that target adaptability skills. Given the aforementioned changes in the current military operating environment, such training has become an important priority in today's Army. The specification of adaptive leadership processes and attributes provides the foundation for a consideration of appropriate adaptability training strategies. However, insufficient understanding about the critical training content and design parameters that contribute uniquely to growth in adaptability skills represents an impediment to the successful development of adaptability training programs (Kozlowski, 1998; Smith, Ford, &

Kozlowski, 1997). Research by Marks et al. (2000) and Burke (1999) indicated that team mental models contributed effectively to adaptation. These mental models were, in turn, influenced by the kinds of information provided by leaders prior to actual performance trials. These studies did not investigate the effects of feedback, or information provided by leaders *during* or *after* performance trials, on team mental models and team adaptation. The provision of particular kinds of feedback represents a critical aspect of effective adaptive leadership as well as a component of most effective training interventions (Goldstein & Ford, 2002; Kluger & DeNisi, 1996). However, there has been relatively little empirical research to examine the role of feedback in specifically enhancing team adaptation. Evidence of such influence would provide valuable suggestions for the design of leader and team adaptability training programs.

### *Research Objectives*

This report describes a research program that sought to investigate the just-outlined research directions. Specifically, this program examined the following research questions.

*1. How do feedback processes influence team adaptability?*

Prior research has demonstrated the importance of a leader's sense-giving processes in fostering team adaptability (Burke, 1999; Marks et al., 2000). In those studies, teams that received sufficient information prior to performance about changing circumstances and the necessary collective responses adapted more effectively than teams that received partial or no information. Further, the quality of team mental models mediated the influence of leader sense-giving processes on team adaptability.

The present research program examined the role of feedback processes in team adaptability. Burke (1999) and Marks et al. (2000) investigated information provision as a *feedforward* process, occurring prior to team interaction. The current investigations examined the processes of providing information about just completed performance exercises. Such feedback should enhance team mental models and help teams adapt to future episodes requiring qualitatively different performance strategies.

*2. Which training and development strategies promote individual and team adaptability?*

Feedback represents both an important leadership process in team action and a critical component of effective training programs (Goldstein & Ford, 2002; Kluger & DeNisi, 1996). Therefore, findings pertinent to the first research question will provide important information for adaptability training. However, the present research effort examined the influence of two additional training and development parameters on variables related to adaptability.

One parameter concerned the variability of performance exercises experienced by a team. Teams that work through problems requiring qualitatively different performance strategies, paired with appropriate performance feedback, should evidence qualitatively superior mental models and greater adaptability than teams working through more routine problems. Evidence of such effects should offer the basis for more effective leader and team adaptability training strategies.

The research team in this effort also examined developmental work experiences as a second parameter that should influence growth in team adaptability skills. Prior research has examined such experiences as a key process in leader development (McCauley, Eastman, & Ohlott, 1995; Ohlott, 1998), but not as a strategy for developing specific attributes that promote adaptability. Developmental assignments present leaders with difficult challenges, novel performance requirements, and, in many instances, greater adversity (McCauley et al., 1995). Therefore, leaders who successfully complete such assignments should gain particular skills and knowledge that can help them respond to dynamic situations requiring adaptability.

3. *Which cognitive, social, and dispositional attributes promote leader flexibility and adaptability? How do these attributes moderate the influence of adaptability training and development interventions?*

Zaccaro (2001) proposed a number of cognitive, social, and dispositional attributes as important precursors to effective executive leadership. Some of these attributes apply as well to effective adaptive performance. Another objective of this research effort was to begin to examine this proposition. In addition, certain leader attributes—such as metacognitive skill and tolerance for ambiguity—could moderate the influences of feedback and developmental experiences on the growth of adaptability skills. This effort also investigated such potential influences.

## Leader and Team Adaptability: Conceptual Models

The next section of this report summarizes several of the conceptual frameworks and models that formed the bases for more specific hypotheses examined in each investigation. While some models came from prior research (see cited references for additional details), others were derived as part of the present effort. The research team reviewed the extant literature and developed concepts and models around the following questions:

- What is the nature of adaptability?
- What key leadership processes promote adaptability?
- What attributes of the leader promote individual and team adaptability?
- What is the role of developmental work assignments in promoting leader adaptability?

### *The Nature of Adaptability*

#### *Defining Adaptability*

Specifying the determinants and processes of adaptability requires first a cogent definition of adaptation that distinguishes it from other types of performance (Campbell, McCloy, Oppler, & Sager, 1993; Pulakos et al., 2000). In this effort, adaptability was defined as *a functional change (cognitive, behavioral, and/or affective) in response to actual or correctly anticipated alterations in environmental contingencies* (Banks, Bader, Fleming, Zaccaro, & Barber, 2001, p. 4). This definition is similar to others offered in the nascent literature on adaptability (Chan, 2000; LePine, 2003; LePine, Colquitt, & Erez, 2000; Ployhart & Bliese,

2006; Pulakos et al., 2000). For example, Chan (2000, p. 6) suggested that "adaptation refers to the process by which an individual achieves some degree of fit between his or her behaviors and the new work demands created by the novel and often ill-defined problems resulting from changing and uncertain work situations." This definition, as well as the one used in the present research effort, emphasizes the *processes* of adaptation. Pulakos et al. defined adaptation as a *performance requirement*, reflecting jobs in which incumbents needed to respond frequently to novel and dynamic circumstances. They offered an eight-dimension model of such requirements. Finally, Ployhart and Bliese (2006, p. 13) examined adaptability from an *individual difference perspectiv*e, defining it as "an individual's ability, skill, disposition, willingness, and/or motivation to change or fit different task, social, and environmental features." Thus, the recent literature has begun to examine adaptability as a set of individual differences, a set of individual and team processes, and as a dimension of performance.

Our definition, along with the others cited, suggests several critical and distinguishing points about adaptability and adaptation. First, adaptive behavior, by a leader or a team, occurs, reactively or proactively, within the context of a shifting alignment between the individual (or unit) and the operating environment. In most instances, the shifts occur in the environment; however, changes in the individual (e.g., non-incapacitating injury, physical impairment, changes in motives or needs) also can require an adaptive response, even if the external situation has remained fairly stable. Also, while some researchers argue that adaptation represents a reactive response to change (LePine, 2003), truly effective adaptors can see potential changes on or over the horizon. They can then act to either shape how these changes might emerge (e.g., by changing adjustable factors in their own operating environment) or by preparing personal and collective contingencies (Zaccaro, 2001).

A second aspect of these definitions notes that environmental changes are of sufficient magnitude that a leader's unit or organization becomes increasingly misaligned with operational conditions (Chan, 2000). Thus, an effective adaptive response is defined as one that brings the leader and/or the unit into realignment with its embedding environment. This point indicates two other aspects of the definitions offered of adaptive performance. Adaptive behavior represents a *qualitative* shift in strategies and tactics as operating conditions change. Leaders and units are not engaging in "more" (or less) of the same behavior—rather, they fundamentally alter their performance strategies. Chan (2000, p. 6) notes that "established and routine behaviors which were successful in the "old" situations prior to the creation of new problems become irrelevant, ineffective, suboptimal, or less successful in the 'new' situation." Thus, adaptive leaders and teams are able to formulate and implement *qualitatively* different response patterns as change occurs. This raises still another aspect of the aforementioned definitions. Adaptive responses represent not just any change in behavior—adaptation is functional, meaning that the new responses are effective in addressing changing circumstances. Change for the sake of just doing something different may be flexibility, but it is not adaptability.

These points suggested prescriptive guidelines for the operationalization of adaptability in this research effort. Specifically, the assessment of adaptive performance should reflect a qualitative shift in performance tactics, processes, and activities by individuals and teams in response to environmental changes that require such a shift. Thus, for the laboratory investigations in this effort, adaptation was operationalized as a team's performance on a trial in which

operating conditions have shifted considerably from those of previous performance trials. Indeed, these shifts were of sufficient magnitude to entail what Smith et al. (1997) referred to as relatively strong adaptability requirements for performers. The survey or field assessments of adaptability processes and performance in this effort also emphasized qualitative shifts in response to environmental change.

*The Nature of Adaptation*

Defining adaptive performance represents the initial step in a comprehensive, conceptual framework of Soldier adaptability. Next steps include defining the characteristics and dimensions of adaptive performance, and the individual and team processes that contribute to the display of adaptability. The next sections of this report contain a review of research in these areas.

*Adaptive performance dimensions*. Functional change in response to altered environmental contingencies represents the core aspect of adaptive performance. However, adaptability can be required across performance situations that differ in some fundamental qualities. Pulakos et al. (2000, p. 301) specified and defined the following dimensions of adaptive performance:

- *Handling emergencies or crisis situations*: "Reacts appropriately and decisively to life-threatening or dangerous situations."
- *Handling work stress*: "Remains calm under pressure, handles frustration, and acts as a calming influence."
- *Solving problems creatively*: "Solves atypical, ill-defined, and complex problems."
- *Dealing with uncertain and unpredictable work situations*: "Adjusts and deals with unpredictable situations, shifts focus, and takes reasonable action."
- *Learning work tasks, technologies, and procedures*: "Anticipates, prepares, and learns skills needed for future job requirements."
- *Demonstrating interpersonal adaptability*: "Adjusts interpersonal style to achieve goals, working with new teams, coworkers, or customers."
- *Demonstrating cultural adaptability*: "Performs effectively in different cultures, learning new languages, values, traditions, and politics."
- *Demonstrating physically oriented adaptability*: "Adjusts to various physical factors such as heat, noise, uncomfortable climates, and difficult environments."

Pulakos et al. (2000) validated their dimensions using a critical incident methodology in one study, and, in a second study, administering a job description instrument based on these dimensions to workers in a variety of jobs, including several military positions. Each of the above-noted behavioral dimensions contains the core elements of environmental challenge and the need for job incumbents to develop new behavioral patterns in response to this challenge. This taxonomy provides a means of describing jobs in terms of their adaptability requirements; it does not, however, specify the processes and skills that contribute to effective performance in jobs containing high levels of such requirements. The next step in this line of research, then, would be to define the leadership and problem-solving processes that would form the basis or springboard of adaptive responses.

*Adaptability processes.* Adaptation represents a distinct, complex problem-solving process. Mumford, Mobley, Uhlman, Reiter-Palmon, and Doares (1991) defined eight processes associated with creative problem solving. These were: problem construction, information encoding, cognitive category search, category specification, category combination and reorganization, idea evaluation, solution implementation, and solution monitoring. Davidson, Deuser, and Sternberg (1994) offered a similar classification. Mumford et al. (2000) extended these problem-solving processes to leadership (see also, Fleishman, Mumford, Zaccaro, Levin, Korotkin, & Hein, 1991; Mumford & Connelly, 1991; Zaccaro, Mumford, Connelly, Marks, Gilbert, & Threlfall, 2000; and Zaccaro, 2001). This body of research served as the basis in this effort for a specification of processes used by leaders in adaptive performance.

Adaptation can be considered as a problem-solving process, in which individuals and units need to resolve problems created by a misalignment with the operating environment. From this perspective, the following six adaptation processes can be specified:

- Scanning and monitoring environmental contingencies and organizational performance strategies;
- Diagnosing the nature and meaning of observed changes in the environment;
- Formulating changes to existing strategies, tactics, and plans;
- Managing the implementation of change solutions;
- Motivating change in others; and
- Affirming the realignment between the unit (organization or team) and its environment.

Adaptation requires ongoing scanning of the environment to note changes in key contingencies and structural patterns. To be adaptive, leaders need to first be aware that a key change has occurred, one that may possibly require an organizational adjustment. This scanning process also includes an awareness of organizational performance strategies. Thus, the first process of adaptation involves the observation of changes in events and an initial determination by the leader that such changes are of a magnitude to make current performance strategies obsolete. The increasing misfit between environmental events and organizational performance strategies triggers adaptive problem solving.

Mumford et al. (1991) and Mumford et al. (2000) defined the initial processes of complex problem solving as involving problem construction and an analysis of the meaning of problem parameters. Accordingly, the second process of adaptive problem solving entails sense-making (Weick, 1993) or diagnosing the nature and meaning of changing events in the environment. Here leaders need to make several judgments, including understanding the implication of changes for the organization's existing strategic direction, determining which changes can be ignored and which must be addressed, and specifying the parameters of possible solution paths. Environmental changes may result in well-defined problems in which the problem parameters and solution paths are clearly specified; or they may pose ill-defined problems in which the initial problem state, solution paths, and requisite end state are not at all clear (Holyoak, 1984).

The diagnosis of change events and the specification of possible solution paths lead to the third adaptation process: the formulation of adaptive responses. Leaders need to develop a plan

for addressing the organizational issues created by environmental change. Such plans can reflect switching to alternate solutions in the organization's repertoire, or they may entail the development of novel solutions.

The first three adaptation processes reflect primarily cognitive activities on the part of the leader to diagnose change and derive solutions. The next two processes are concerned with the implementation of formulated plans. Managing the implementation of solutions involves leaders helping followers perceive and understand the changes occurring in their operating environment Burke, 1999; Marks et al., 2000). Solution implementation in adaptive contexts may also require leaders to change team goals, as well as roles and interaction patterns among team members (LePine, 2003). Solution implementation also requires that leaders procure any material resources necessary for change, and help subordinates learn new responses that are part of the change solution (Fleishman et al., 1991).

The fifth adaptation process that motivates change in others is directed specifically at overcoming individual and collective resistance to change. By virtue of their role in a team or organization, leaders often perceive change and understand its implications before their subordinates. Accordingly, subordinates need to be convinced of the necessity of change (Kotter, 1996), and that the change strategies developed by the leader will be effective. If leaders are successful in their sense-giving communications and in persuading subordinates of the efficacy of the change strategy, then their subordinates are likely to display more commitment to the change.

The final adaptation process entails affirming that the change strategy is being carried out properly, and that the unit is indeed improving its alignment with its operating environment. Such processes reflect those in models of self and team regulation (Kane, Zaccaro, Tremble, & Masuda, 2002) that specify an iterative series of goal performance checks to determine that the unit is successfully accomplishing established goals. If the progress in implementing the change strategy is insufficient, or the change strategy proves inadequate to realign the organization with its changed environment, then the leader will need to recalibrate, revise, or replace his or her change strategy (Kane et al., 2002).

This classification of adaptation processes served as part of the criterion space for several of the investigations completed in this research effort. These processes also provided the basis for exploring how leaders help teams become more adaptive. This research effort adopted the functional perspective of team leadership, described in more detail in the next section of this report.

### *Leadership and Team Adaptability*

Research on team adaptation, and in particular how leaders produce effective and adaptive teams, has been fairly limited (Stagl, Burke, Salas, & Pierce, 2006; LePine, 2003). A key distinction between team adaptability and individual or leader adaptability is that team adaptation requires a *collective* adjustment to environmental change. Accordingly, team members need to coordinate their adjusted behaviors with one another to produce an integrated response to such changes. This often entails changing role structures within the team (LePine,

2003). Likewise, members need to pool their resources and capabilities when adapting to change. Specifically, how these resources are combined and which member resources are emphasized will likely shift as environmental changes occur. Also, the levels of certain individual differences that compose the team are likely to determine the fundamental capacity of the team to adapt successfully.

Developing the adaptive capacity of the team and facilitating the processes of recombining resources and redefining member roles as change occurs represents a central responsibility of the team leader (Kozlowksi, 1998; Zaccaro, Rittman, & Marks, 2001). There are relatively few conceptual models of how leadership processes lead to team effectiveness. One perspective of leadership, the functional leadership approach, however, specifically addresses in broad terms the leader's relationship to the team (Fleishman et al., 1991; Hackman & Walton, 1986; Lord, 1977; Mumford, Zaccaro, Harding, Fleishman & Reiter-Palmon, 1993). This perspective defines leadership as a social problem-solving process. Two fundamental processes of team leadership include establishing the direction for collective action and managing the role assignments, activities and interaction processes of team members to achieve assigned team missions (Zaccaro, 2001; Zaccaro et al., 2001).

Along these lines, Fleishman et al. (1991) described a set of basic requisite leadership functions that are linked to the effective generation, selection, and implementation of problem solutions (see also, Mumford et al., 1993, Mumford et al., 2000). Zaccaro et al. (2001) proposed that functional leadership activities contribute to team adaptation by influencing the motivational, cognitive, and coordination processes that help teams respond to dynamic and complex environmental conditions. Thus, leaders can foster adaptive teams by raising the collective efficacy of team members so they can respond effectively to change, by developing shared mental models that contribute to effective adaptation (Marks et al., 2000, Burke, 1999), by facilitating the collective information processes that occur within the team as the operating environment changes, and by fostering more adaptive team coordination.

A key to this leadership influence is the development of cognitive structures such as shared mental models and transactive memory systems that enable the team to respond effectively to shifting environmental performance contingencies. Shared mental models refer to knowledge structures held, in part or whole, in common across team members (Cannon-Bowers, Salas, & Converse, 1990; 1993; Zaccaro et al., 2001). These knowledge structures emerge from collective team experiences and encode expected co-action and interaction patterns during team performance. One of the most important of these shared mental models encodes the expected interaction patterns of team members at various stages of different performance episodes. Cannon-Bowers et al. (1993; p. 232) called such models “team interaction mental models” and argued that team members:

> ...must understand their role in the task that is their particular contribution, how they must interact with other team members, who require particular types of information, and so forth. Related to this, they must also know when to monitor their teammates’ behavior, and when to step in and help a fellow member who is overloaded, and when to change his or her behavior in response to the team.

At more complex levels, team interaction models presumably encode cue-contingency links (Burke, 1999), in which team members share information about which courses of collective actions are appropriate in different team performance scenarios. When environmental dynamics begin to shift, teams with well-developed shared team interaction mental models should be more effective in shifting team responses than teams with underdeveloped or inaccurate team interaction models (Cannon-Bowers et al., 1993). Effective reactions to such shifts also may derive from using knowledge from the team's transactive memory.

Transactive memory refers to the common knowledge within the team of which member possesses a particular expertise or set of resources (Wegner, 1987; 1995). Leaders and team members could develop new responses to environmental change in part from an awareness of the collective and individual member resources of the team, and knowledge of the different ways team members are capable of working together.

Complex shared team interaction mental models and transactive memory systems may contribute to the overall *adaptive expertise* (Holyoak, 1991) in the team. Kozlowski (1998; p. 119) argued that:

> Adaptive expertise entails a deep comprehension of the conceptual structure of the problem domain. Knowledge must be organized, but the structure must be flexible. The process goes beyond procedural knowledge of an automatic sort. Adaptive experts understand when and why particular procedures are appropriate as well as when they are not. Comprehension entails active processing, allowing recognition of shifts in the situation that necessitate adaptability. Adaptive experts are able to recognize changes in task priorities and the need to modify strategies and actions.

When team leaders and members possess adaptive expertise, they have a better understanding of which team actions are more likely to be effective in different performance situations, and when new actions must be designed. Adaptive expertise, composed in part of complex team interaction models (with elaborate cue-contingency linkages) and transactive memory, facilitates the development of these novel responses.

A functional perspective of team leadership suggests that team leaders have an important responsibility to help team members develop shared adaptive expertise. They do so by the knowledge and data they convey to members, including information about possible and actual changing environmental contingencies, the meaning of these changes and their implications for subsequent team action, and the required team adjustments in terms of roles and interaction patterns (Burke, 1999; Marks et al., 2000). These leader communications help prepare the team to anticipate change events and react effectively to them.

Marks et al. (2000) and Burke (1999) provided evidence for this leadership effect. Marks et al. manipulated both the amount of team interaction training and the quality of leader briefings given to team members prior to simulated computer-based military missions. Teams completed one routine mission that reflected the same scenario and performance requirements encountered in training, and two novel missions in which success required strategies different from those in

the training and routine scenarios. Before each mission, teams received either a limited briefing that indicated team goals, or an enriched briefing that included information about significant risks in the mission, how such risks should be handled, opportunities on the battlefield, and action priorities. Dependent measures included the accuracy and degree of similarity in team mental models, and team performance on each of the missions. Results indicated that the enhanced leader briefings increased both the accuracy of team mental models and the degree of similarity among the models of individual team members. Shared and accurate mental models in turn influenced team performance on the adaptive tasks—indeed, the effects of mental model similarity on performance were stronger on the novel tasks than on the routine tasks.

Burke (1999) completed a similar study, but instead parsed leader briefings into four levels reflecting finer distinctions in the information conveyed. One level entailed the leader conveying mission goals; the second level involved the leaders relaying to the team information about the mission environment; the third level provided cue-contingency linkages for the team, where team members were instructed in how to respond; the final level of leader briefing quality provided both cue-contingency information and a rationale for certain team actions that needed to occur in particular environments. The last type of leader communication was designed to enhance the complexity of shared team interaction models, contributing to growth in adaptive expertise. Teams completed one routine and one novel mission. Measures included team mental models and team performance. Results indicated that the quality of leader briefings enhanced both the accuracy and degree of sharedness in team mental models, which in turn positively influenced team performance. Specifically, the analyses showed that only teams receiving the enhanced briefings that included a rationale for cue-contingency linkages were able to adapt successfully to the novel environment.

Taken together, these studies (Burke, 1999; Marks, Mathieu, & Zaccaro, 2001) indicate the importance of leader communication prior to team interactions for the development of shared mental models. Note that the key leadership communications involve relaying cue-contingency information along with a rationale for their link—that is, what team members must do under different performance conditions and why those actions are appropriate in particular situations. Often, in mission planning, Army officers will engage in “rehearsals” with their staff and members of their unit. These interactions have the same purpose: to preview unit actions and discuss contingent responses to alternate mission events. Soldiers have indicated that this is a key process in helping them to be adaptive (R. Pleban, personal communication, September 2, 2004).

While the shared mental models emerging from leader performance briefings contribute significantly to team adaptive expertise, leader communications about past performance episodes should also play a role in team adaptation. While leader briefings provided before team performance episodes can help develop the kinds of cue-contingency models necessary for adaptive mental models, leader feedback after such episodes should confirm, correct, and/or strengthen these models. Kluger and DeNisi (1996) defined feedback as “actions taken by (an) external agent(s) to provide information regarding some aspect(s) of one’s task performance” (p. 255). In teams, team leaders are the most likely agents (outside of formal training settings) providing feedback to individual members and to the team as a whole. While the assumption is that feedback can help performance, Kluger and DeNisi demonstrated that past empirical results are mixed, with as much as 38% of effect sizes from past studies indicating a negative effect of

explicit feedback on performance situations. Most prior studies did not focus on dynamic or adaptive performance contexts. Thus, the influence of feedback in adaptive performance situations needs additional attention.

Kluger and DeNisi (1996) offered a model and several propositions regarding both motivational and learning effects of feedback. Motivational effects result from reactions to discrepancies between feedback and prior goals or standards. When feedback indicated less than standard performance and increased effort could reduce this discrepancy, the effect was greater task motivation and effort. Kluger and DeNisi, though, found that if increased effort could not reduce the feedback-standard discrepancy, recipients who had high beliefs in success shifted their attention to learning efforts. In addition, they indicated that the provision of task details in feedback focuses attention on key performance requirements. Task learning processes induced by feedback also include the development of hypotheses about appropriate behavior patterns, with subsequent actions confirming these hypotheses (strengthening performance) or disconfirming them and generating new hypotheses (provided success is still perceived as likely). These kinds of learning processes are particularly important in developing adaptive mental models and, subsequently, adaptive expertise (Smith et al., 1997).

Kluger and DeNisi (1996) noted that the content of feedback is crucial to the learning process. The provision of mere performance data (outcome information) can "impede learning of complex tasks and subsequently task performance" (p. 263). This feedback effect can be particularly detrimental in adaptive performance situations, when the presence of dynamism or ambiguity raises task complexity. Kluger and DeNisi noted that such feedback impairs performance by causing recipients to search for alternate task strategies, many of which will be futile and less effective than the original strategy. The provision of process feedback, where recipients are provided more informative details about appropriate performance strategies may improve performance, but only if alternate strategies are indeed superior to existing actions. In sum, to improve performance through increased task learning, process oriented feedback needs to "help the recipient to reject erroneous hypotheses" (Kluger & DeNisi, 1996, p. 265). Kluger and DeNisi concluded from meta-analysis moderator analyses that most feedback interventions do not provide such information. Regarding adaptation, the development of shared mental models in teams arguably represents a critical team learning precursor to subsequent performance in dynamic circumstances; process-oriented feedback provided by a leader-agent may be the key influence on such learning and development.

The provision of outcome-only versus process feedback reflects only one dimension that may influence the development of adaptive mental models. The level of the feedback—that is, at the individual- or the team-level—is another dimension that can influence team adaptation (Gully, 1997; Nadler, 1979). The development of shared mental models may be influenced in part by whether feedback reflects only individual member behavior, or whether it focuses on team level processes and outcomes (Nadler, 1979). The literature on team-level feedback is relatively sparse with a number of central questions still unanswered (Hinsz, Tindale, & Vollrath, 1997). The results of prior studies on which level of feedback is more effective for facilitating performance are mixed (Nadler, 1997), and few if any such studies differentiated outcome-only versus process feedback. The present research effort will examine the influences of these feedback parameters on team adaptation.

In sum, while prior research has demonstrated that leaders help their teams become more adaptive by providing detailed briefings prior to team missions, the present effort tests the proposition that greater team adaptability also will accrue from the provision of particular forms of feedback after team performance missions. While a number of studies have examined the effects of feedback on performance (Ilgen, Fisher, & Taylor, 1979; Kluger & DeNisi, 1996), little research has explored the role of feedback on particularly promoting team adaptation. By investigating this question, this research effort extends prior studies on feedback and performance, and also provides implications for training adaptability (see below).

The conceptual frames described thus far have focused on leadership activities that should foster team adaptation. This research effort also examined leader attributes and individual differences that contribute to the effective display of such activities. The next section of this report briefly describes these attributes.

### *Leader Attributes*

Zaccaro (2001) argued that leader flexibility emerged from an integrated constellation of *cognitive*, *social*, and *dispositional* attributes. A key point of this model is that the three sets of individual attributes act *jointly* to influence adaptability processes and performance: That is, leader effectiveness and adaptability can be understood as deriving from patterns of individual differences that combine exponentially to influence leadership activities. Adaptability was defined earlier as deriving from the application of complex problem-solving processes in a dynamic environment. This perspective suggests that adaptation processes reflect the combined influence of social appraisal, problem-solving skills, and expertise. Successful problem solving requires an accurate appraisal of social system requirements and dynamics (Zaccaro, Foti et al., 1991). In turn, social appraisal depends heavily upon social expertise that can be applied to interpret social events (Cantor & Kihlstrom, 1987; Zaccaro, Gilbert et al., 1991). Likewise, problem construction (a key problem-solving skill) requires appropriate knowledge stores that can be used to interpret events in a problem space (Mumford et al., 2000). And the development of successful solutions contributes to subsequent growth in leader expertise. Thus, regarding leader adaptability, each set of cognitive, social, and knowledge attributes depends upon—and contributes to—each other set in its effect on leadership.

As part of this research effort, we used our definition of adaptability, our specification of leader adaptation processes, and recent studies on individual differences and adaptability (Chan, 2000; Judge, Thoresen, Pucik, & Welbourne, 1999; LePine, 2003; LePine et al., 2000; Pulakos et al., 2002) to identify other attributes within each set that may contribute to an individual's capacity to adapt to shifting environmental contingencies. Table 1 summarizes these attributes.

Table 1
*Summary of Leader Adaptability Attributes*

| Cognitive Attributes | Social Attributes | Dispositional Attributes |
|---|---|---|
| General cognitive ability<br>Cognitive complexity<br>Cognitive flexibility<br>Metacognitive capacities<br>Complex problem-solving skills<br>Adaptive expertise<br>Tacit knowledge | Social acuity and appraisal skills<br>Behavioral flexibility<br>Communication competence<br>Emotional intelligence | Openness<br>Need for cognition<br>Tolerance for ambiguity<br>Optimism<br>Self discipline<br>Achievement striving<br>Emotional stability<br>Risk tolerance<br>Resilience; hardiness |

In the present research effort, the attributes noted in Table 1 were used as predictors, mediators, and moderators of adaptability variables across the investigations. Several of these attributes acted either as *outcomes* (e.g., social competencies and tacit knowledge,) of training and development interventions designed to grow adaptability skills, or they *moderated* (e.g., metacognitive skills) the effects of training parameters (such as feedback) on adaptive performance.

This research effort also included an exploration of some training and development parameters that may enhance leader adaptability skills. The next section of this report describes the conceptual frame used for this exploration.

### *Training and Developing Adaptability*

The specification of leader adaptability processes and corresponding leader qualities provides the foundation for the development of leader and team training and development systems. Traditional training strategies have focused on (1) enhancing an individual's behavioral repertoire, or (2) developing skills applicable within specific contexts (e.g., team building or communication skills). However, adaptive performance reflects neither a set of trainable behavioral routines, nor a set of contextually prescribed skills. Instead, effective adaptability rests on skills in environmental pattern recognition, and pattern change recognition, skills in critical thinking and sense-making, skills in formulating adaptive responses, and skills in regulating one's own behavior and that of unit members under one's leadership.

Training adaptability skills requires growth strategies different from those traditionally employed (Smith et al., 1997). Most training strategies utilized in the military and in businesses focus on developing routine expertise, with the goal of automatizing the targeted skill set (Holyoak, 1991; Kozlowski, 1998; Smith et al., 1997). To grow adaptability skills, training needs to focus instead on developing adaptive expertise (Smith et al., 1997). Such training needs to target active learning and self-regulation strategies that foster skills in knowing how and when to adapt to changing circumstances (Kozlowkski, 1998, Smith et al., 1997). Also, the design of such

training should prompt the development of comprehensive knowledge structures and skills that form the basis for adaptive expertise. Finally, the principles of such training need to extend across different modes of leader development, including formal instruction and work assignments.

This research effort focused on two sets of training variables and how they might influence the learning of adaptive thinking and behavior. The first set included training design parameters: specifically, feedback and complex stimulus variety. The second set focused on developmental work assignments.

*Training Design*

The potential effects of feedback (as a form of leadership communication) on team adaptability were described earlier in this report. Feedback also represents a critical training parameter necessary to facilitate learning activities (Kluger & DeNisi, 1996). Accordingly, the findings in this report regarding leader feedback also can be extrapolated to adaptability training design.

Adaptive expertise entails the encoding of cross-situational principles that reflect a deeper understanding of the overall performance domain (Kozlowski, 1998). Accordingly, adaptability training needs to include design parameters that can foster the generation of such principles. Stimulus variety as one such principle refers to providing the trainee with an array of examples and scenarios that differ significantly on key features (Kozlowski, Toney, Mullins, Weissbein, Brown, & Bell, 2001; Smith et al., 1997; Gick & Holyoak, 1987). By engaging in such different scenarios, trainees should develop more comprehensive cue-contingency mental models and therefore be better able to handle novel performance situations. Thus, in addition to the role of feedback in developing adaptability, this research effort explored training stimulus variety as a critical adaptability training tool.

*Developmental Work Experiences*

Operational assignments represent one of the modes of learning in the U.S. Army's leader development system. Leader development through experiences is grounded in a series of "typical" command and staff assignments that can occur at several key junctures of an officer's career. Some assignments focus more on proceduralizing skills gained through formal instruction. Other assignments challenge the leader's current skill set to encourage a process of acquiring new and more complex skills. Similar experiences in business settings have been called developmental assignments (McCauley, Ruderman, Ohlott, & Morrow, 1994; Ohlott, 1998)

The central premise of developmental work experiences is to provide challenging work assignments to budding leaders that push them to construct new understandings of their more complex operating environment. McCauley et al. (1995; Ohlott, 1998) identified several job

components that act as developmental work experiences (DWEs). These components include five categories of developmental experiences:

- Transitions,
- Creating change,
- High levels of responsibility,
- Nonauthority relationships, and
- Obstacles.

These categories subsume 13 subcategories of more concrete DWEs. *Transition experiences* involve assignments calling for the manager to work on novel projects, in new positions, or with unfamiliar responsibilities. *Creating change* involves assignments requiring managers to formulate and implement change within the organization. Such assignments also entail resolving problems in groups and units inherited by the manager. *High responsibility experiences* entail assignments with broader scopes of responsibility and with problems having significant importance for larger numbers of organizational units. Development experiences around *nonauthority relationships* involve assignments in which managers must use influence strategies that are less based on directive authority and more on persuasion and collegiality. Experiences that involve *confronting obstacles* require incumbents to resolve difficult circumstances that, potentially, can obstruct goal progress.

McCauley et al. (1995) and Ohlott (1998) specified the content of different types of developmental assignments. Tesluk and Jacobs (1998) offered another model in which they described other dimensions of work experience, including its frequency of occurrence and its timing during an individual's career. They argued that certain individual differences can moderate the influences of developmental assignments, by determining who might receive such assignments, or which assignments different individuals would choose to complete. Other characteristics (e.g., metacognitive skills) may influence what lessons individuals derived from such assignments.

There has been limited research linking work experience, especially developmental experiences, to variables associated with leader adaptation and performance. Accordingly, the research effort described in this report examined development work experiences and their effects on personal attributes related to adaptation. These investigations also explored the moderating influences of certain individual differences on these relationships.

### *Summary*

Several conceptual frames guided the empirical investigations completed in this research effort. The primary focus of this research is on the leader's role in promoting team adaptability, and the attributes that contribute to the successful completion of this role. The remainder of this report describes a mix of laboratory and field investigations, using samples that included undergraduate students, business leaders, and military officers from the U.S. Army and the Air Force. Taken together, the results of these investigations advance several of the conceptual ideas presented thus far.

While most of the conceptual frames guiding the present effort derived from existing literatures, portions of the following papers summarized themes developed in this research effort:

Zaccaro, S. J. (2002). Organizational leadership and social intelligence. In R. Riggio, S. Murphy, & F. J. Pirozzolo (Eds.), *Multiple intelligences and leadership* (pp. 29–54). Mahwah, NJ: Lawrence Erlbaum Associates.

Zaccaro, S. J., & Banks, D. (2004). Leader visioning and adaptability: Bridging the gap between research and practice on developing the ability to manage change. *Human Resource Management Journal, 43,* 367–380.

## Leadership and Team Adaptability: Summary of Empirical Investigations

### *Investigation 1: Feedback Level and Content—Effects on Team Adaptation*

#### *Overview and Hypotheses*

As noted in the conceptual summary, leaders can influence the development of adaptive mental models and team adaptation through sense-giving and "feed-forward" processes (Burke, 1999; Marks et al., 2000). However, they also affect team adaptation by providing feedback on team performance episodes in a manner that facilitates growth in such shared mental models. Studies examining specific effects of feedback on team mental models and adaptation are relatively sparse. This investigation contrasted outcome only feedback with feedback that included both outcome and process information. Process-oriented feedback includes descriptive information of how the task was performed, what errors were committed, and what strategies can be used to improve performance. Accordingly, such feedback provides data to recipients to test and confirm hypotheses about adaptive behavior (Kluger & DeNisi, 1996).

This investigation also contrasted individual and team level feedback. Research on this difference has been mixed. Nadler (1979) reported that individual-level feedback was more likely to result in performance increments. However, Gully (1997) found that individual-level outcome feedback reduced performance, while team-level feedback slightly improved team performance. Hinsz et al. (1997) confirmed the confusion of findings in the literature, suggesting that more research attention be given to these research questions.

The teams in the present investigation were required to complete a highly interdependent task. Thus, to maximize team learning from trial performance episodes, feedback needed to reflect the interdependence property of the team task and provide information about how the team members as a whole were working together. Also, such feedback needed to include both outcome and process information (Blickensderfer, Cannon-Bowers, & Salas, 1994; 1997; Johnson, Turban, Pieper, & Ng, 1996). Accordingly, this investigation tested the hypothesis that feedback content and feedback level will jointly influence team performance, such that teams receiving a combination of process and outcome feedback at the team level will perform better on an adaptation task than teams receiving other forms of feedback.

This investigation also tested the proposition that several individual differences, aggregated to the team level, would moderate the influence of feedback as a training intervention on team adaptation (Ford, Smith, Weissbein, Gully, & Salas, 1998; Gully, Payne, Koles, & Whiteman, 2002). Such effects may take the form of "aptitude by treatment" interactions (Snow & Lohman, 1984) where feedback effects are stronger for individuals possessing high levels of certain individual differences. This investigation examined three such attributes: *cognitive ability*, *cognitive flexibility*, and *metacognitive skills*. Each attribute should increase the likelihood that feedback recipients can learn from proffered information and develop more effective and accurate team performance strategies (e.g., Ford et al., 1998; Gully et al., 2002). Accordingly, another set of hypotheses tested in this investigation stated that the effects of feedback level and content on team adaptation would be stronger for teams of individuals high in cognitive ability (Hypothesis 2), cognitive flexibility (Hypothesis 3), and metacognitive skills (Hypothesis 4).

A secondary purpose of this investigation was to conduct an exploratory examination of the effects of social intelligence, metacognitive skill, and openness to experience on leader emergence. Leadership rankings were used to determine who emerged as a leader within the team. These three attributes were selected as representing the three sets of important leader attributes—social, cognitive, and dispositional—identified by Zaccaro (2001). Because not all teams clearly indicated an emergent leader and other teams had members with missing data on key attributes, this research question could only be explored with a subset of the total sample.

*Method*

*Participants and design*. The participants in this investigation included 186 undergraduate students organized into 62 three-person teams. The experiment utilized a 2 (individual vs. team level feedback) by 2 (outcome only vs. process and outcome feedback) factorial between-group design. Another 22 teams were collected in a condition that provided no feedback at all. The purpose of this latter condition was to explore leader emergence in teams that did not receive any feedback. Because the influence of no feedback was not a research question in this experiment, this cell was not included in analyses examining the hypotheses.

The teams in this experiment completed a revised version of a commercially available computer-based military simulation game (i.e., "Command and Conquer: Red Alert"). This task was chosen because it required a high degree of team interdependence, and allowed experimenter control to manipulate task complexity and other features necessary to increase the adaptive performance requirements of the task. The generic mission for each team was to effectively destroy a series of enemy structures. Before each mission, team members received a briefing that detailed their primary and secondary objectives in terms of targets to destroy.

Each team member operated a separate division of the Armed Forces (Army, Navy, or Air Force). The three forces were assigned different capabilities to foster interdependence. Air Force units had the capability of rapid movement, but their assets could only be used for short periods before needing to be reloaded. These assets were also very expensive and easily destroyed. The Navy also had the capability of rapid movement, but was limited to water or shore areas. The Army could engage in sustained battles with enemy units, but needed the Navy to move around the battle

environment. To succeed, the three team members needed to utilize their strengths to compensate for each other's weaknesses.

*Manipulations*. Before beginning the performance trials, team members completed task and team training modules in which they learned how to play the game, learned each other's capabilities and weaknesses, and viewed a video about how to work effectively together to complete the team mission. They completed a total of three missions in the practice period. The first was a 5-minute practice trial to acquire experience in the game. The next two missions lasted 10 minutes each and provided the setting for delivery of the feedback manipulations. Teams were provided a map of the battlefield showing primary and secondary objectives. In each mission, enemy units were programmed to stay stationary and act defensively, only retaliating against any attack.

Team performance was defined as the total number of points earned from destroyed targets—primary targets were worth 20 points, while secondary targets were assigned 10 points. Teams were randomly assigned to receive one of four feedback protocols. In the individual/outcome protocol each team member was informed publicly about the number of points earned by the actions of his or her units. In the team/outcome protocol, team members received feedback about the total number of points scored by the team as a whole. In the individual/process protocol each team member was given feedback both about the number of points he or she earned, and about the behavior and processes of that member during the performance trial. In the team/process condition, teams received performance scores and information about how members operated on the task as a team.

Team members had unique roles, so the "leader" had to remain separate from the group, but also be perceived as sufficiently knowledgeable about the game to give believable feedback that was associated with actual performance events. Also, one purpose of this investigation was to gather leader emergence scores. Thus, a confederate leader could not be assigned to the group (cf. Burke, 1999). Because feedback needed to be veridical, pre-scripted leader communication was not possible (cf. Marks et al., 2000). Accordingly, an experimenter took the role of "team leader." Team members were instructed that this person would be monitoring team actions and providing instructions and feedback after each performance episode. However, team members were responsible for all other leadership decisions during the simulated battle.

*Measures*. Team adaptation was assessed by having teams complete a mission in which several parameters were adjusted to make the task more difficult and complex (Burke, 1999; Marks et al., 2000). Specifically, enemy units were reprogrammed to move and actively seek out and destroy team assets. Also, the time of the mission was expanded to 15 minutes, and additional enemy objectives were inserted. The mission brief provided limited information regarding enemy strength and the location of primary and secondary objectives. These changes required more vigilance on the part of team members as enemy unit and objectives kept shifting. Team performance was operationalized as the total points accrued for destroyed primary and secondary enemy targets.

Before beginning the task and team training exercises, team members completed several individual difference measures, including cognitive ability (i.e., Wonderlic Personnel Test, Wonderlic, 1984), cognitive flexibility (Martin & Rubin, 1995), metacognitive skills (Pintrich, Smith, Garcia, & McKeachie, 1993), social intelligence (Zaccaro, Zazanis, Diana, & Gilbert, 1995), and openness to experience (Saucier, 1994). All of the measures have demonstrated acceptable

reliability in prior research. Leader emergence was assessed through leader rankings and ratings. After each mission, team members rank-ordered their choices as a team leader if they were asked to work together again in the future. Also, each team member rated each other member on several dimensions of team leadership (Zaccaro, Foti, et al., 1991). Experimenters used these rankings and ratings to determine the leader for each team. When these data were ambiguous regarding the choice of a leader, the team was discarded from analyses on individual differences and emergent leadership.

*Procedure*. After arriving at the experimental setting, participants completed informed consent forms, a background information survey, and the battery of individual differences measures. Each person was then randomly assigned to a role within a team, and each team was randomly assigned to conditions using a counterbalanced design. Team members completed 2 hours of task and team training, moving forward only after completing a knowledge test regarding the training material. After training, teams received the feedback manipulation in two practice episodes. Before each exercise, teams were first briefed on their mission and then given a 5 minute planning period. After this planning period, teams completed the 10 minute practice mission, followed by one of the four feedback conditions. After completing the practice trials, teams participated in the adaptative performance task. Following this exercise, participants were debriefed regarding the purpose of the experiment and dismissed.

*Summary of Results*

All variables in this experiment *except* the adaptation task performance score indicated a normal distribution. Accordingly, analyses of performance data were completed on square root transformed scores. Table 2 indicates the intercorrelations among key variables in the research. A 2 x 2 analysis of variance performed on the team adaptation scores indicated no significant main effects for feedback content (means: outcome feedback = 6.98; process feedback = 6.98) or feedback level (means: individual-level = 6.50; team-level = 7.46). However, the interaction of feedback level and content was significant ($F(1, 54) = 5.54$, $p < .05$). Figure 1 illustrates the nature of this interaction. Post hoc analyses indicated significant differences only between teams receiving team-level process feedback and teams receiving individual-level process feedback. Thus, Hypothesis 1 received partial support in that teams receiving team-level feedback that contained both process and outcome information exhibited the highest team adaptation scores. However, the significant interaction found in the adaptation scores also was due, unexpectedly, to the drop in performance exhibited by teams that received individual level, process feedback.

Table 2
*Correlations Among Key Measured Variables—Investigation 1*

| | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Adaptive performance | 1.00 | | | | |
| 2. Cognitive ability | .01 | 1.00 | | | |
| 3. Cognitive flexibility | .10 | -.10 | 1.00 | | |
| 4. Metacognitive skill | .02 | -.14 | .15* | 1.00 | |
| 5. Social intelligence | -.01 | -.01 | .14 | .12 | 1.00 |
| 6. Openness | .08 | .08 | .08 | .09 | .14 |

*Note.* *$p < .05$.

Moderated regression analyses were used to test Hypotheses 2-4. The results indicated no support for cognitive ability and cognitive flexibility as moderators of feedback effects. However, in support of Hypothesis 4, a moderated regression analysis indicated a significant three-way interaction with average metacognitive scores in teams. The incremental R2 for the 3-way product terms was .14 ($\Delta$ $F(1, 49) = 9.67$, $p < .05$). Figures 2 (high metacognitive skill) and 3 (low metacognitive skill) illustrate the plot of regression lines for feedback level and content at different metacognitive skill levels. As expected, higher levels of metacognitive skills in team members enhanced feedback effects. Of particular interest, though, is the significant decline in team adaptation scores when team members receive individual-level process and outcome feedback.

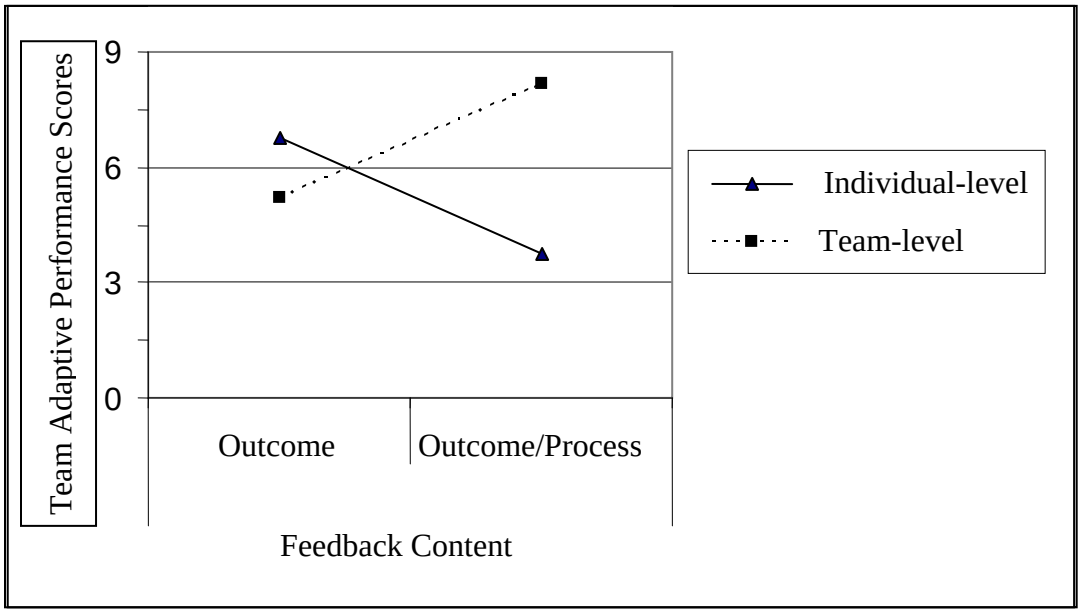


*Figure 1.* The interaction of feedback content and level on team adaptive performance scores.

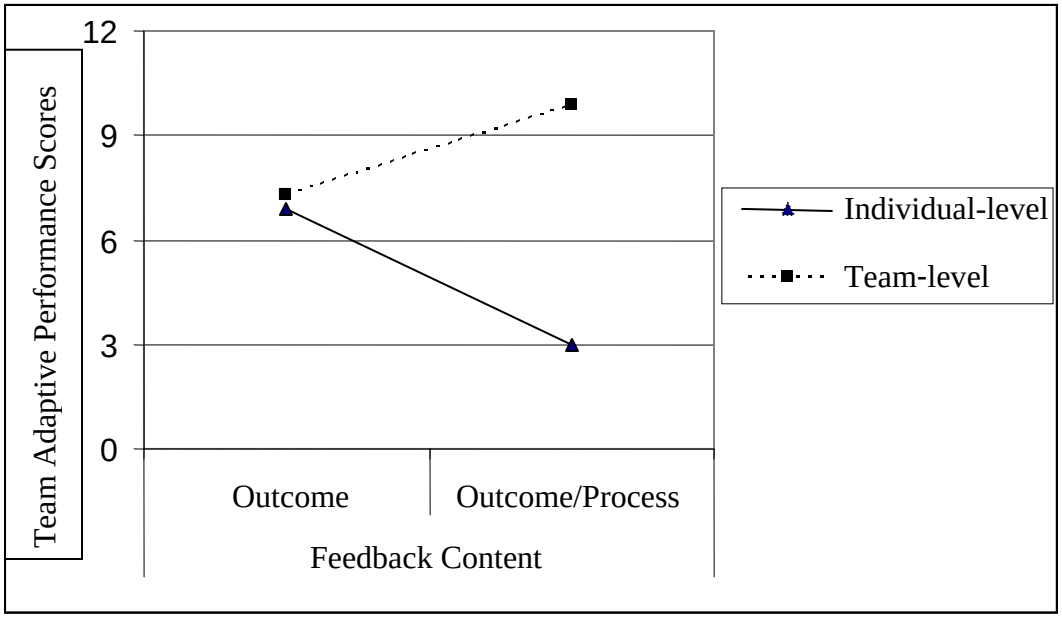


*Figure 2.* The interaction of feedback content and level on team adaptive performance scores: High metacognitive team skills.

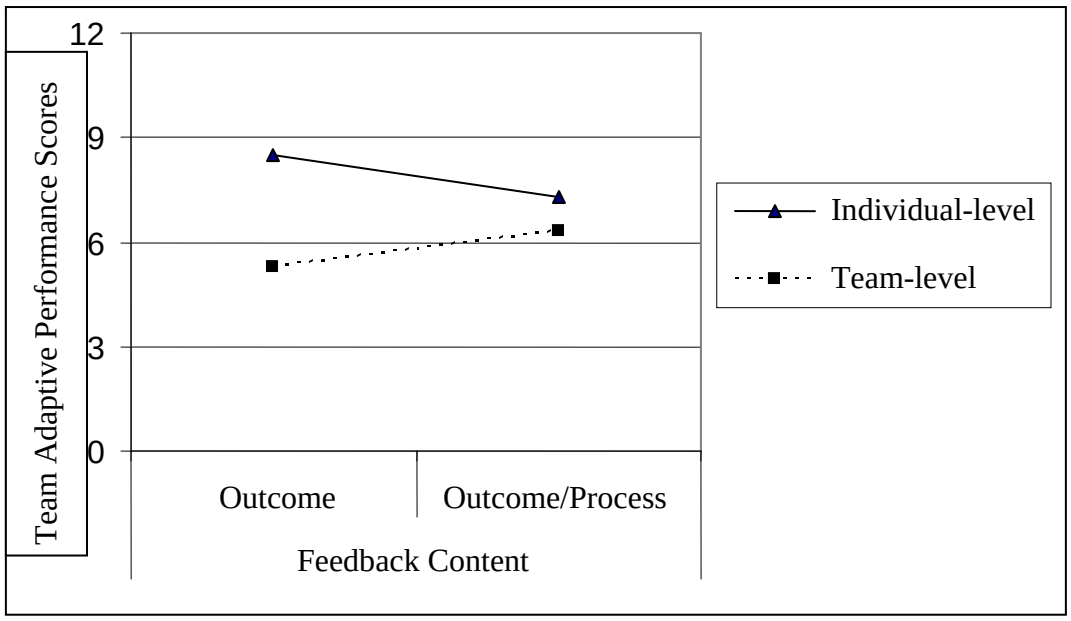


*Figure 3.* The interaction of feedback content and level on team adaptive performance scores: Low metacognitive team skills.

Team members were coded as leaders or nonleaders on the basis of their assigned rankings and ratings. Thirty-four groups yielded both a clear leader and no missing data on key measured

variables. A multivariate logistic regression was performed, regressing leader emergence scores on the three individual differences and feedback condition (including the control condition). The analyses indicated an overall Cox and Snell $R^2$ of .43. Feedback conditions did not explain any variance in leader emergence. However, metacognitive skill ($z = 7.61$, $p < .05$), social intelligence ($z = 20.07$, $p < .05$), and openness to experience ($z = 5.18$, $p < .05$) each accounted for significant unique variance in leader status. The small sample size did not allow a test of the attribute pattern hypothesis that high levels of all three attributes would be significantly different from all other combinations. Also, the three leader attributes did not predict any variance in team performance.

*Discussion*

The results of this investigation extend previous research in several important ways. Marks et al. (2000) and Burke (1999) found that leader communications that provided critical cue-contingency information prior to performance missions resulted in more adaptation. In the present experiment, feedback provided after performance missions also contributes to team adaptation. However, the interaction found between feedback level and feedback content indicates that such communications need to (a) target the team as a whole, and (b) provide information both about overall team outcomes *and* about the activities and processes engaged by the team during its mission. The three-way interaction with metacognitive skill suggests that feedback communication will be more effective when team members possess a high degree of capability to reflect upon the provided information.

The large decline in performance when teams were given individual level and process feedback provided a particularly interesting and unexpected finding. One possible explanation may stem from the public nature of the feedback administration. In the individual level, process feedback condition, team members received information on their own outcomes and on their specific role activities. Because performance episodes occurred immediately after training, serving as practice trials, feedback was largely centered on errors made and the most appropriate corrections for future missions. The public nature of the individual feedback, however, may have sensitized team members to their own behavior, resulting in attentional shifts to the self and less concern about overall team integration and performance. Kluger and DeNisi (1996) noted that feedback, particularly negative information, may trigger affective reactions, focus attention on self-cognitions, and deplete cognitive resources for task performance. The consequence can be reduced performance, particularly when the task is difficult or complex. The next investigation in this research effort examined these possible explanations for the observed effects on individual level, process oriented feedback by manipulating both the level and administration (public vs. private) of feedback.

The results of the leader emergence analyses indicated some support for some of the proposed leader adaptability attributes. Metacognitive skills, social intelligence, and openness were associated with leader emergence scores. However, these attributes did not predict team adaptive performance. The relatively small subsample size of teams that clearly indicated an emergent leader did not allow for a test of the remaining individual differences or a test of the attribute pattern hypotheses. This research question is examined in other investigations in this research effort.

*Research Products*

Kiechel, K. L., Marsh, S., Boyce, L. A., Chandler, C., Fleming, P. J. & Zaccaro, S. J. (2000). *Feedback in a team context: The impact of feedback characteristics on multiple levels of performance.* Paper presented at the 15th annual meeting of the Society for Industrial and Organizational Psychology, New Orleans, LA.

Marsh, S., Kiechel, K. L., Boyce, L. A., & Zaccaro, S. J. (2001). *Leader emergence and functional leadership: The role of leader traits and information provision in adaptive situations*. Paper presented at the 16th annual meeting of the Society for Industrial and Organizational Psychology, San Diego, CA.

## *Investigation 2: Feedback Level, Public Versus Private Feedback, and Feedback Sign—Effects on Team Adaptive Performance*

Note: A full description of this experiment and its findings are provided in the following source:

Koles, K. L. K. (2001). The impact of feedback-induced self attention on antecedents of team performance. *Dissertation Abstracts International, 62* (2-B), 1127 (UMI No. 3003052).

*Overview and Hypotheses*

The results of Investigation 1 indicated that team-level, process-oriented feedback was most effective in fostering team performance on a task requiring adaptation to shifting environmental conditions. Accordingly, such communications should be part of the leader's repertoire of activities to facilitate team adaptation. However, the finding that teams receiving individual-level, process feedback displayed a significant drop in performance compared to teams receiving other forms of feedback raises a number of questions regarding the effects of such information provision. Also, investigation 1 did not address possible mediators of feedback effects on team performance, nor did it distinguish the effects of positive (i.e., success) versus negative (i.e., failure) performance information. Investigation 2 was designed to answer these questions.

In this experiment, three characteristics of feedback provision were varied: level (team vs. individual), administration (public vs. private), and sign (positive or negative). These feedback parameters can influence team adaptation through four mediating mechanisms: self-focused attention, motivation toward the team, shared mental models, and collective efficacy to handle change. Feedback provided to individual team members rather than to the team as a whole can result in greater self attention and fewer cognitive resources devoted to the team (Cusella, 1987; Kluger & DeNisi, 1996). Team level feedback can increase team member motivational orientation to the team as a whole (Nadler, 1979). Likewise, team-level feedback can facilitate the emergence of more accurate shared mental models (Blickensderfer et al., 1997).

A greater level of motivation to the team and shared mental models should promote collective efficacy and team adaptation (Burke, 1999; Marks et al., 2000).

The effects of feedback level may be moderated by the public or private administration of the feedback. Public feedback may heighten the self-attentional focus of team members receiving individual level feedback, with a resulting decline in motivational orientation to the group (Kluger & DeNisi, 1996). Tetlock (1983) argued that public feedback may result in individual members engaging in more social comparison processes within the team, and having higher concerns about how they are perceived by other team members.

Not all of the effects of public feedback may be negative. London (1997) argued that public feedback in teams helps foster a greater understanding of individual and team processes and activities. This understanding should contribute directly to more accurate mental models shared among team members. Thus, the potential overall effects of public versus private feedback are unclear, particularly when administered to the individual versus to the group as a whole.

Another point of ambiguity refers to the sign or tone of provided feedback. Negative feedback is more likely to trigger self-attention and to direct cognitive resources away from task performance, particularly on complex tasks (Kanfer & Ackerman, 1989; Kluger & DeNisi, 1996). Also, negative feedback can lower self and collective efficacy (Bandura, 1986, 1997; Zaccaro, Blair, Peterson, & Zazanis, 1995). Positive feedback should have the opposite effects, increasing team motivation and team adaptation.

In sum, leader feedback can vary along three dimensions—level, administration, and sign—and influence team adaptation through four possible mechanisms: self-focused attention, motivation toward the team, collective efficacy, and the quality of subsequent shared mental models. The purpose of this second experiment was to examine the effects of the three aforementioned dimensions of feedback on possible mediators and on adaptive performance. The core hypothesis for this experiment is that teams receiving individual-level private feedback would perform significantly worse than teams receiving other forms of feedback.

*Method*

*Participants and Design*. The participants in this experiment included 171 undergraduate students organized into 57 three-person teams. The experiment utilized a 2 (individual vs. team-level feedback) by 2 (public vs. private feedback) factorial between-group design. Teams completed the *Command & Conquer: Red Alert* simulation used in Experiment 1.

*Manipulations*. As in the first experiment, team members took on the roles of Army, Navy, and Air Force, while the experimenter had the position of "external team leader," responsible for providing feedback to the team. Individual versus team-level feedback was administered using the same procedures as in Experiment 1. All feedback provided contained both outcome and process information. However, one half of the teams received feedback publicly, again as in Experiment 1, while the other half received either individual-level or team-

level feedback privately on paper distributed to each team member. The feedback provided was veridical relative to the performance of the team on the preceding task.

*Measures*. Measures of self attention, motivation towards the team, and collective efficacy were developed for this experiment. Self attention was assessed using a six-item measure asking members to indicate on a five-point Likert scale their agreement with such items as "I feel more self conscious about my performance" (1 = strongly disagree, 5 = strongly agree). Scale reliability was .70. Motivation towards team concerns was assessed with a six-item measure. Items asked participants to indicate if they were more motivated to concentrate on their own roles or on helping the team as a whole perform well. The reliability for this scale was .60, suitable for a new measure (Nunnally, 1978). Collective efficacy was measured with eight items asking participants to indicate their level of confidence in their team's capability to perform mission-key actions. An interclass correlation indicated that 12% of the variance in this measure was accounted for by group membership (ICC (1) = .12; ICC (2) = .30), justifying the combining of these items to form a group level construct.

Team mental models were assessed by asking team members to indicate which 3 (out of 12) behavior patterns were most critical for success in four possible team scenarios. Sharedness was determined by calculating the percentage of responses shared by two or three members of the team (Burke, 1999). To assess feedback sign, points were assigned to each feedback comment made to the team or individual members—1 point for a negative comment; 2 points for a neutral comment, 3 points for a positive comment. As in the first experiment, adaptive team performance was operationalized as the point total accrued from destroying primary and secondary targets during the final performance trial.

*Procedure*. After arriving at the experimental setting, participants completed informed consent forms and a background information survey. Then each person was randomly assigned to a role within a team, and each team was randomly assigned to conditions using a counterbalanced design. Team members completed the same training protocol described in Experiment 1. After training, teams completed two practice performance trials, receiving the feedback manipulations after each one. On each trail, teams were first briefed on their mission and then given a 5-minute planning period. After this planning period, teams completed the 10-minute performance episodes, followed by one of the four feedback conditions. The self-attention, motivation toward the team, and collective efficacy measures were administered after Mission 1. The mental model measure was administered after Mission 2. After completing the practice trials, teams participated in the adaptation exercise. Following this exercise, participants were debriefed regarding the purpose of the experiment and dismissed.

*Summary of Results*

Table 3 indicates the correlations among the variables in this experiment. Greater self-attention was associated with lower motivation toward team concerns. Feedback sign was positively associated with such motivation, and with collective efficacy. Thus, team emergent states (Marks et al., 2001) were related to one another in expected ways.

A multiple regression analysis was used to test the effects of feedback level, administration, and sign on mediators and outcomes. The three feedback parameters were entered at Step 1, 2-way interactions at Step 2, and the 3-way interaction at Step 3. As a set, feedback parameters explained 9% of the variance in self-attention ($F(3, 167) = 5.53$, $p < .01$). As expected, feedback level influenced self-attention (Beta = .30, $p < .01$). Individual-level feedback resulted in team members expressing greater self-attention than members of teams receiving team-level feedback. Whether the feedback was public or private, or positive or negative did not influence self-attention; also neither variable moderated the effects of feedback level on self-attention.

Feedback parameters explained 9.3 % of the variance in motivation toward team concerns ($F(3, 167) = 5.71$, $p < .01$). Team-level feedback resulted in members displaying greater motivation for their team than those members receiving individual-level feedback (Beta = .57, $p < .01$). Feedback sign also influenced team motivation, with positive feedback resulting in greater motivation than negative feedback (Beta = .20, $p < .01$). The public or private administration of feedback had no significant effect, nor did it moderate the effects of feedback level and feedback sign. While feedback parameters explained 25% of the variance in collective efficacy ($F(3, 53) = 5.82$, $p < .01$), only feedback sign demonstrated a significant positive influence (Beta = .48, $p < .01$).

Multiple regression analyses were used to examine the effects of feedback administration and level on mental model sharedness and team adaptive performance. The analysis on team mental models indicated a significant amount of variance explained by the manipulations ($F(2, 54) = 5.651$, $p < .01$, $R^2 = .17$); however, this effect was almost entirely due to feedback administration (Beta = -.37, $p < .01$)—public feedback to team members resulted in greater degrees of sharedness than private feedback.

Prior performance in the practice trials was entered at Step 1 in the regression analyses completed on adaptive performance, followed by the manipulations at Step 2, and their interactions at Step 3. After controlling for prior performance, only the interaction of feedback level and administration added significant incremental variance ($F(1, 52) = 4.20$; $R^2$ change = .06, $p < .05$). The interaction is plotted in Figure 4. While feedback administration did not influence team adaptation when given at the individual level, team-level public feedback resulted in significantly higher adaptation than team-level feedback given privately to team members.

Additional analyses helped determine the cause of the significantly lower performance in teams receiving private team-level feedback, relative to all other conditions. First, a one way ANOVA with a Tukey HSD post hoc analysis found that teams in this condition exhibited lower self-directed attention than teams in the other conditions ($F(3, 167) = 5.49$, $p < .01$). Also, teams in the team-level, private feedback condition reported the highest levels of motivation for team concerns ($F(3, 167) = 55.98$, $p < .01$). However, lower self-attention and higher team motivation did not result in better team adaptation. Another explanation is suggested by the analyses completed on team mental models, which indicated significantly *less* sharedness in mental models in teams receiving team-level private feedback ($F(3, 53) = 4.39$, $p < .05$).

A multiple regression analysis was completed on adaptive performance, this time entering Mission 1 performance at Step1; collective efficacy along with self attention and team motivation (both aggregated to the group level) at Step 2; Mission 2 performance at Step 3; and mental model sharedness at Step 4. Both measures of prior performance and collective efficacy explained unique variance in adaptive performance at the final step. After accounting for all other emergent state variables and prior performance, mental model sharedness still explained incremental variance in adaptive performance ($F(1, 50) = 5.58$, $R^2$ change = .05, $p < .05$). The results of this analysis are shown in Table 4. These analyses suggest that the feedback effects on team adaptation were likely due to their influences on team mental models.

Table 3
*Correlations Among Key Measured Variables—Investigation 2*

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| 1. Self-attention[a] | | | | | | | | | |
| 2. Motivation toward team[a] | -.34** | | | | | | | | |
| 3. Mental model sharedness | -.04 | .16 | | | | | | | |
| 4. Collective efficacy | -.22 | .23 | .00 | | | | | | |
| 5. Feedback sign | .06 | .28* | -.19 | .46** | | | | | |
| 6. Mission 1 performance | .17 | .13 | -.07 | .16 | .34** | | | | |
| 7. Mission 2 performance | .00 | .17 | .20 | .09 | .22 | .31* | | | |
| 8. Adaptive team performance | .08 | .15 | .27* | .32* | .04 | .41** | .44** | | |
| 9. Feedback level[b] | .52** | -.38** | -.19 | -.17 | .01 | .02 | .03 | -.02 | |
| 10. Feedback administration[c] | -.06 | -.13 | -.37** | .03 | .19 | .13 | -.13 | -.14 | .02 |

*Note.* N = 57 3-person teams.
*$p < .05$. ** $p < .01$.
[a]Aggregated across team members. [b]Team-level coded 1; individual-level coded 2. [c]Public coded as 0, private coded as 1.
Table adapted from Koles (2001).

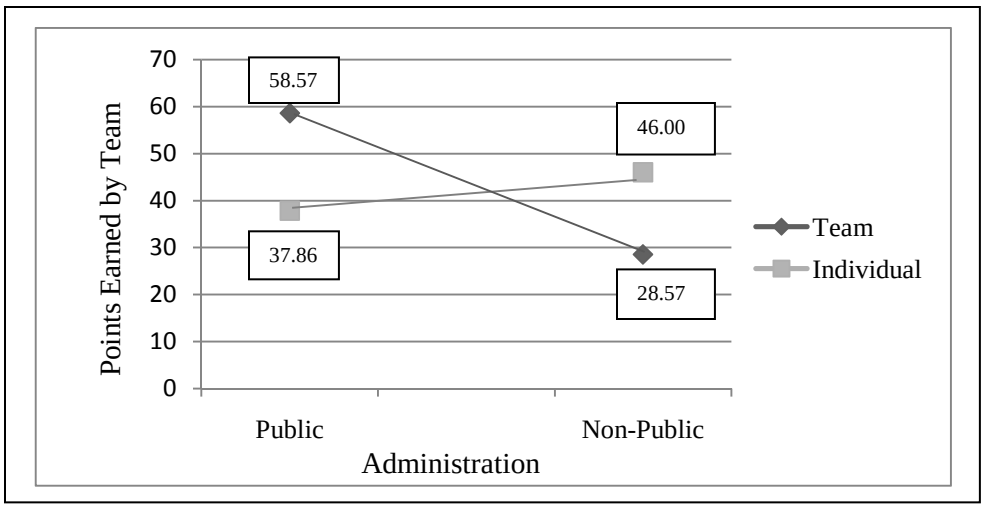


*Figure 4.* The interaction of feedback orientation and administration on adaptive team performance (adapted from Koles, 2001).

*Discussion*

This experiment contributed additional insight into feedback as a leadership tool to promote team adaptability. Prior studies on team feedback are relatively sparse compared to research on individual feedback (DeShon, Kozlowski, Schmidt, Milner, & Wiechmann, 2004; Hinsz et al., 1997; Nadler, 1979). Also, studies examining the effects of team-level versus individual-level feedback have shown mixed results (Gully, 1997; Hinsz et al., 1997). The value of the present research effort stems from contrasting team- versus individual-level feedback (along with other parameters of feedback), and examining the effects of feedback not only on team performance, but also on proposed mediators of feedback effects. Finally, few if any prior studies have examined feedback as a tool for facilitating team performance in dynamic circumstances—that is, team adaptation.

Table 4
*Multiple Regression Analyses on Adaptive Team Performance—Investigation 2*

| IVs | $R^2$ for Equation | $R^2$ Change | b | Beta | *F* |
|---|---|---|---|---|---|
| Step 1<br>Mission 1 performance | .171 | .171 | .67 | .41** | 11.33 |
| Step 2 | .250 | .079 | | | 4.33 |
| Collective efficacy | | | 2.57 | .27* | |
| Mean self-attention | | | 1.65 | .11 | |
| Mean team motivation | | | 1.23 | .08 | |
| Step 3<br>Mission 2 performance | .350 | .100 | .42 | .34** | 5.51 |
| Step 4<br>Mental model sharedness | .400 | .050 | .95 | .23* | 5.58 |

*Note.* N = 57 3-person teams; *$p < .05$, **$p < .01$ (Table adapted from Koles, 2001).

As in Experiment 1, when feedback focused on the entire team and how well (or poorly) team members worked together, the effects on adaptive performance were more positive than if the feedback focused on individual member activities. However, the influence of team-level process feedback depended upon whether such information was provided privately to team members or publicly to the team. Only public team-level feedback resulted in team adaptation. The analyses on the four proximal consequences of feedback suggested that the quality of team mental models explained the positive effects of certain types of feedback on team adaptation. The three characteristics of feedback affected at least one of the proposed mediating variables. Team-oriented feedback led to less self-focused attention and greater team motivation than individual-level feedback. Teams receiving generally positive feedback exhibited higher collective efficacy and stronger team-oriented motivation than teams receiving negative feedback. Unexpectedly, public feedback did not heighten self-focused attention when team members received individual feedback, nor did it lessen motivation to the team. The primary consequence of public versus private feedback administration appeared to be the consequent development of team mental models: such models were more likely to be shared among team members when they received public process-oriented feedback. Such feedback allows members to more easily understand their own roles and activities in connection with those of their peers on the team. The analysis of team performance in the final mission demonstrated the prime importance of shared mental models in helping teams adapt to changing environmental circumstances (see Table 4).

Functional leadership perspectives argue that the key role of the team leader is to facilitate team performance, especially when environmental contingencies shift, by engaging (or fostering) effective team problem-solving processes (Mumford et al., 2000). Marks et al. (2000) and Burke (1999) demonstrated that leaders can facilitate team adaptation by providing process-

oriented information, with action rationales, before teams begin a mission. Both studies also reported evidence for the important role of shared and accurate team interaction mental models in team adaptation, with Burke demonstrating how such models are a direct consequence of the quality of pre-performance leader communications. Experiments 1 and 2 of the present research effort document the importance of the leader *also* providing process-oriented information to the team after performance episodes. Experiment 2 demonstrates that the quality of shared mental models likely mediates the effects of leader feedback on team adaptation. Figure 5 summarizes the proposed influences of leader communication on team adaptation as found across Marks et al. (2000), Burke (1999), and the two empirical investigations summarized here.

Experiments 1 and 2, together with the prior studies by Marks et al. (2000) and Burke (1999), have significant implications for understanding team communications by Army leaders and their consequences for team adaptation. A common means of providing performance feedback in the Army is through after action reviews (AARs). Such reviews have become highly touted as key collective training tools (Morrison & Meliza, 1999). Indeed, Johnson (1999) notes that the "U.S. Army has adopted the After Action Review (AAR) as the primary method of delivering feedback after unit training exercises" (p. iii). Morrison and Meliza point to the AAR as an important leadership tool: "The commander, in his role as the unit's primary trainer, uses all the feedback from the AAR to assess his unit's performance" (1999, p. 4). The excellent review of the AAR process by Morrison and Meliza highlighted several important parameters of effective AARs, including the provision of process versus product information. However, their report does not explicitly address some of the other feedback issues examined in Experiments 1 and 2, including the public versus private administration of feedback, the team as a whole versus individual-level focus of the provided information, and the role of such feedback in promoting *team adaptation* through higher quality team mental models. The results of this research effort confirm that more effective AARs are likely to be those that include a primary emphasis on how unit members did or did not work together during the conduct of a prior mission. AARs typically use public administration of feedback; thus the findings of Experiment 1 (see Figure 4) are particularly pertinent to this conclusion.

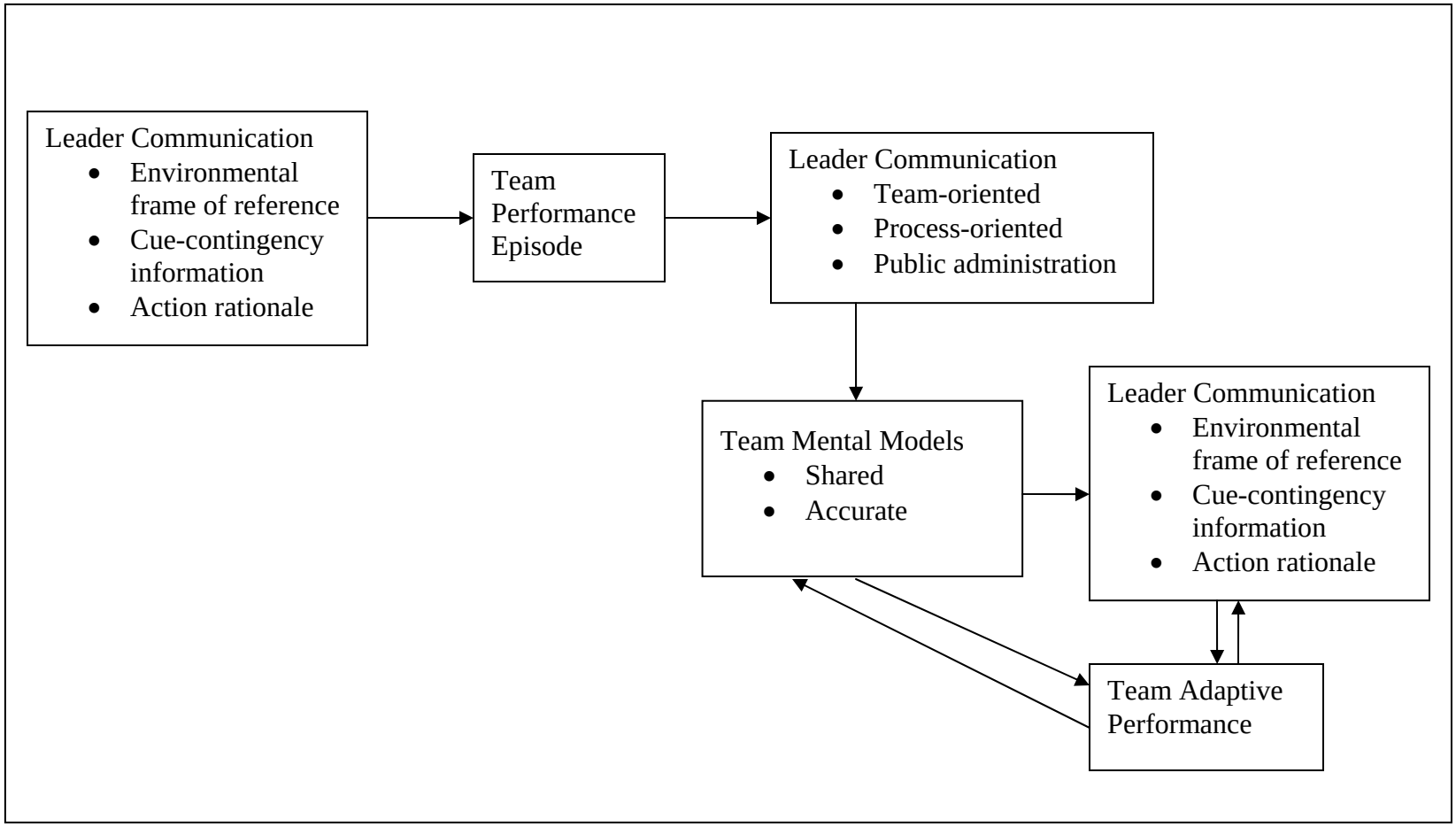


*Figure 5*. Influences of leadership communications on team adaptation.

The use of AARs points to the role of performance feedback as both a leadership and training tool. The current research effort has focused particularly on feedback as a form of leadership communication that facilitates team adaptation. Another objective of this research program was to explore specific training design strategies that foster leader and team adaptation. This objective was the focus of Experiment 3.

*Research Products*

Koles, K. L. K. (2001). The impact of feedback-induced self attention on antecedents of team performance (Doctoral dissertation, George Mason University, 2001). *Dissertation Abstracts International, 62*(2-B), 1127. (UMI No. 3003052)

## *Investigation 3: Feedback and Variability in Training Performance Requirements: Effects on Team Adaptation*

*Overview and Hypotheses*

Smith et al. (1997) argued that training that is intended to grow skill in adaptation needs to emphasize the development of adaptive expertise. Such expertise reflects an ability to understand general principles of performance in a broad problem domain and, more specifically, to know what strategies will work in different situations (Kozlowski, 1998). Kozlowski (1998, p. 119) notes, "Adaptive experts understand when and why particular procedures are appropriate as well as when they are not." Traditional training emphasizes growth in trainee behavioral and cognitive repertoires, with the intent of routinizing the application of skills in a particular performance domain (Smith et al., 1997). Adaptive training requires additional emphases on (a) knowing when existing skills applications need to be modified in response to changing environmental contingencies, and (b) how to develop new kinds of responses (Smith et al., 1997).

One training design parameter that may be instrumental in fostering growth in adaptive expertise is the use of complex stimulus variability across training practice scenarios. Such variability involves presenting the trainee with different scenarios that differ significantly on core critical performance requirements. Schmidt and Bjork (1992; p. 214) indicated that in the case of intentional variation in practice,

> …the criterion test performance typically requires performance on some novel variation not experienced in the acquisition session. The question is whether this intentional variation during practice, versus a consistent practice schedule, is effective for transfer to some novel retention test.

To be effective, changes in training practice scenarios should require significant qualitative alterations in requisite performance strategies—a shift in kind rather than a shift in degree. By experiencing and working with a wide range of performance requirements, trainees can acquire a broader response repertoire and, more important, information on when particular responses are

appropriate or inappropriate—that is, broad cue-contingency models. Trainees also gain experience and insight in confronting and managing significant change in performance domains.

Prior research on practice variability has produced the fairly stable finding that constant practice results in better performance during training but less transfer to novel tasks (Schmidt & Bjork, 1992; Shapiro & Schmidt, 1982). As noted by Schmidt and Bjork (1992; p. 215):

> ...even though constant practice may lead to more effective performance in the acquisition phase, and often more accurate verbatim recall of the material presented, constant practice produces less effective capabilities to generalize knowledge to novel situations than does variable practice.

Most of this research has utilized primarily simple motor or verbal tasks, not the more complex tasks characteristic of most teams (see Holladay & Quinones, 2003, for an exception with individual trainees). Also, perhaps one means of reducing performance decrements from stimulus variability during training, and therefore speeding acquisition of adaptive expertise, may be to pair training scenario variability with process-oriented feedback. Such feedback can assist trainees in developing generalized principles from stimulus variety. Accordingly, this research effort examined the effects of feedback and practice scenario variability on team adaptation in a complex task environment. The hypothesis tested was that practice variability paired with process feedback would result in better performance on a subsequent novel task than practice with consistent scenarios, or practice with variable scenarios but with no feedback. This research also examined the role of collective efficacy (Holladay & Quinones, 2003), shared mental models, and team action processes (Marks et al., 2001) in mediating the influences of feedback and practice variability on adaptive performance.

*Method*

*Participants and design*. The participants in this experiment included 198 undergraduate students organized into 66 three-person teams. The experiment utilized a 2 (feedback vs. no feedback) by 2 (variability vs. consistent scenarios) factorial between-group design. Teams completed the same military simulation used in Experiments 1 & 2. A pilot investigation using a design similar to the one below found significant effects for feedback, but no effects for variability, nor a significant interaction. Accordingly, the variability manipulation was strengthened to increase the need for qualitatively different performance strategies in each practice scenario.

*Manipulations*. As in the first two experiments, team members took on the roles of the Army, Navy, and Air Force, while the experimenter had the position of “external team leader” responsible for providing feedback to the team. Teams either received no feedback after performance trials, or received the combined process and outcome feedback as described in Experiment 1. Teams randomly assigned to the practice variability condition were asked to complete three different practice scenarios, each varying from the others on key parameters such as terrain, location of targets and defenses, and numbers of enemy. These variations required significant shifts in the team actions for success. In the consistent condition, teams completed the same general mission three times with no change in mission parameters across the practice trials.

*Measures*. Participants completed a number of demographic measures at the start of the experiment, as well as an assessment of the Big 5 personality attributes (openness, conscientiousness, extroversion, agreeableness, and emotional stability; Saucier, 1994). Self and task efficacy were measured with revised instruments similar to the one used in Experiment 2. Team mental models also were assessed, using a revised version of the measure used in Experiment 2. Team action processes were assessed through experimenter ratings of four communication and coordination team behaviors, derived from Marks et al. (2001) that were determined to be linked to adaptive performance. These behaviors were (a) monitoring progress toward goals, (b) systems monitoring, (c) team monitoring and back-up behavior, and (c) team coordination. Marks et al. provided the definitions of these behaviors. Experimenters rated the occurrence of each specific behavior on a 5-point Likert scale ranging from "Never" to "Always." As in Experiments 1 and 2, adaptive team performance was operationalized as the point total accrued from destroying primary and secondary targets in the adaptation performance trial.

*Procedure*. After arriving at the experimental setting, participants completed informed consent forms, the background information survey, and the personality assessment. Each person was then randomly assigned to a role within a team, and each team was randomly assigned to conditions using a counterbalanced design. Team members completed the same training protocol described in Experiment 1. After training, teams completed either three consistent or three variable practice performance missions. Teams were first briefed on their mission and then given a 5-minute planning period. After this planning period, teams completed the practice missions. The mental model and collective efficacy measures were administered after the third practice trial. After completing the practice trials, teams participated in the adaptation exercise. Following this exercise, participants were debriefed regarding the purpose of the experiment and dismissed.

*Summary of Results*

Analyses of the personality measures indicated that conscientiousness, averaged across team members (i.e., team conscientiousness; see Barrick, Stewart, Neubert, & Mount, 1998, for a discussion of personality and team composition) was significantly and negatively related to adaptive performance ($r = -.29$, $p < .05$). None of the other personality variables were related to any of the criteria in the research and, accordingly, were not used in any further analyses. Table 5 indicates the correlations among the key variables used in the analyses for this experiment.

Due to the significant negative correlation between team conscientiousness and adaptive performance, an ANCOVA controlling for team conscientiousness was conducted on team adaptation scores. This analysis indicated a significant main effect for feedback ($F(1, 64) = 15.82$, $p = .01$), and a marginal feedback by variability interaction ($F(1, 65) = 3.22$; $p = .078$). The pattern of the interaction, displayed in Figure 6, indicates that variability marginally improved performance only in the presence of feedback. Analyses of the team processes and emergent states variables also indicated that:

- Teams receiving feedback were rated as engaging in more team action processes ($M = 3.54$) compared to those in the no feedback condition ($M = 2.79$; $F(1, 65) = 15.45$, $p < .05$).

- Teams receiving feedback had higher collective efficacy ($M$ = 3.99) than those not receiving feedback ($M$ = 3.73; $F(1, 66) = 5.638$, $p < .05$)
- Teams receiving variability in training had marginally lower collective efficacy ($M$ = 3.78) than those receiving no variability ($M$ = 3.96; $F(1, 66) = 3.017$, $p = .09$).
- Teams receiving feedback had greater sharedness in their mental models ($r$ = .64) than teams receiving no feedback ($r$ = .54; $F(1, 57) = 9.72$, $p < .01$).
- Teams receiving variability in training had less sharedness in their mental models ($r$ = .56) than teams receiving no variability ($r$ = .62; $F(1, 4.67) = 9.72$, $p < .05$).

Table 5
*Correlations Among Key Measured Variables—Investigation 3*

| | 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|
| 1. Adaptive performance | | | | | | |
| 2. Team action processes | 0.15 | | | | | |
| 3. Shared mental models | 0.02 | 0.15 | | | | |
| 4. Collective efficacy | 0.12 | 0.26* | 0.41** | | | |
| 5. Team conscientiousness | -0.29* | 0.19 | -0.01 | -0.01 | | |
| 6. Variability | 0.06 | -0.10 | -0.25 | -0.22 | -0.20 | |
| 7. Feedback | 0.27* | 0.45** | 0.37** | 0.30* | -0.15 | -0.06 |

*Note.* *$p < .05$, **$p < .01$.

*Discussion*

The results of this experiment demonstrated once again the importance of team-level, process-oriented feedback for adaptive performance. When confronted with a changed battlefield, teams receiving feedback on prior performance missions outperformed teams that did not receive prior performance feedback. This experiment also demonstrated some additional proximal consequences of process feedback. Teams that received such feedback displayed more appropriate action processes during performance episodes and higher levels of collective efficacy and shared mental models. Thus, Experiment 3 of this research effort replicated the evidence from Experiments 1 and 2 for feedback as a leadership communication tool to enhance team adaptation.

Variability of practice scenarios marginally influenced adaptive performance, but only in the presence of feedback. This suggests that as a training strategy, such a practice design needs to be paired with process-oriented feedback that helps team members make sense of changing environmental contingencies and decide the appropriate collective response. Such feedback should quicken the development of adaptive expertise from the experience of multiple and qualitatively different practice scenarios. *However, the marginality of the interaction effect*

*indicates the need for additional research, perhaps focusing on other training factors that can further strengthen the effects of practice variability.*

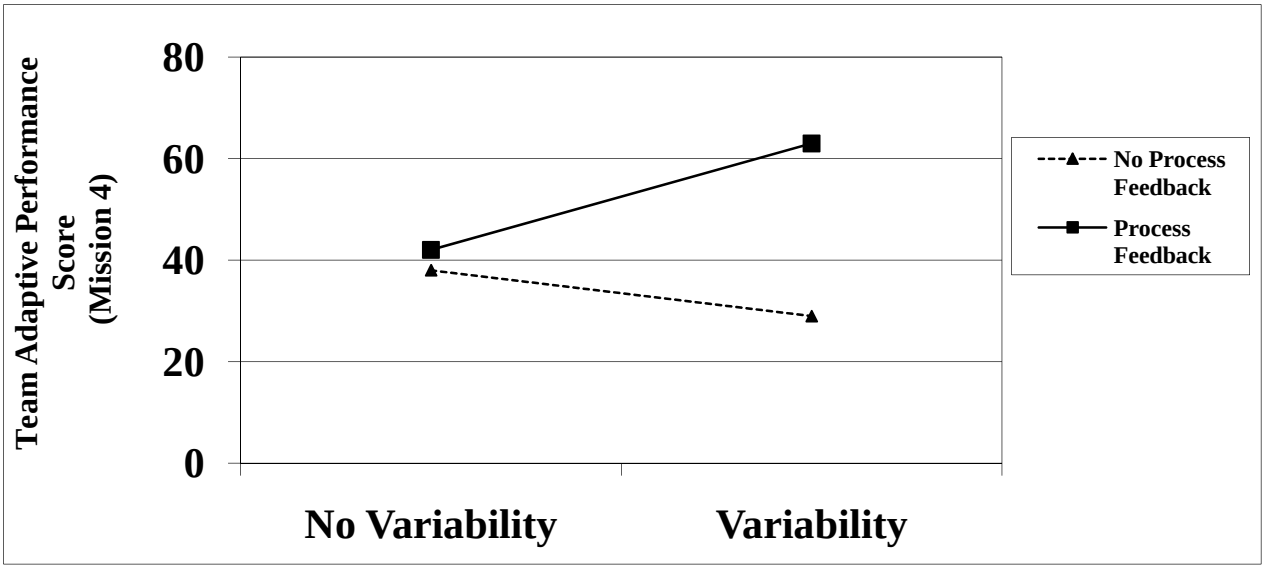


*Figure 6.* Feedback by variability interaction.

Interestingly, teams receiving practice variability indicated lower ratings of collective efficacy and shared mental models than teams receiving constant training scenarios. These findings resemble other studies that reported deleterious effects of practice variability (Schmidt & Bjork, 1992). The facilitative effects of variability appear in transfer to novel situations (Holladay & Quinones, 2003). Indeed, Holladay and Quinones found that variability raised generalized self-efficacy, or one's confidence about doing well on a variety of tasks. The efficacy beliefs in this experiment referred to specific collective task competence.

In addition to exploring ways of strengthening the effects of practice variability, further research will need to identify the key mediating mechanisms for these effects. The extant literature and the findings of this experiment suggest that practice variability in team training may produce a generalized collective efficacy, or an efficacy for dealing with change. Such variability also may produce more abstract and complex mental models that encode the kinds of principles characteristic of adaptive expertise. Finally, such variability may enhance the likelihood of team members engaging in more "frame-switching" processes at different stages of team performance episodes. Frame-switching refers to a process of altering one's perspective on a problem in a manner that produces a new way of constructing the problem, or a novel solution path (see Hong, Morris, Chiu, & Benet-Martinez, 2000) for an example of cultural frame-switching). Teams that train in a manner that constantly requires change may proceduralize frame switching as part of their cognitive problem-solving activities more readily than teams that experience relative scenario constancy in their training. Future research will need to parse these different explanations for practice variability effects on team adaptation.

The negative correlation between conscientiousness and adaptive performance is also an interesting finding. LePine et al. (2000) reported a similar finding in a study on individual personality and adaptation. They determined from further analyses that conscientiousness was related to higher levels of dutifulness, order, and dependability. Such an orientation may suggest an adherence to rules and a reluctance to adopt unconventional approaches to performance. LePine (2003) examined this finding further in a study of team composition and team adaptation. He separated two parts of the definition of conscientiousness—achievement and dependability—arguing that while the former would enhance elements of adaptation, the latter would have negative influences. He found support for these effects. The findings of the current experiment regarding conscientiousness and adaptation add to this literature. Further research is necessary to determine how such conscientiousness may influence adaptability training interventions, or vice versa.

As shown in Table 5, shared mental models had no significant effects on adaptive performance. This was surprising in light of the findings of Experiment 2, and the results of Marks et al. (2000) and Burke (1999). To investigate the nature of shared mental models further, an exploratory investigation with 27 three-person teams was completed to examine different ways of assessing mental models, and their common or distinct effects on team adaptation. Also, this research examined the issue of whether mental models reflected either the similar performance contexts experienced by the team or the idiosyncratic combination of particular team members. After completing two missions of the *Command and Control: Red Alert* military simulation, teams in one condition experienced a turnover of team membership, such that no member worked again with the same individual on the next mission. In the other condition, teams stayed intact. Then all teams completed a third mission. If mental models are idiosyncratic to the team, then the degree of sharedness among team members should decline when team membership is totally altered. If shared mental models derive from the common experience of members across all teams, then rotating team membership should have minimal effect on the degree of sharedness among mental models of members reassigned to new teams.

*Shared Mental Models: Further Investigation*

Participants completed four types of mental model measures after Missions 1 and 2. These were a paired comparison task (Goldsmith, Johnson, & Acton, 1991), a cue-contingency measure (similar to the one used in Experiments 2 and 3 of this effort), a content analysis measure (Carley, 1997), and a concept map assessment (Marks et al., 2000). The paired comparison task required team members to judge the degree of relatedness of pairs of concepts. These concepts were derived from a cognitive task analysis by subject matter experts in the *Command and Control: Red Alert* military simulation. Then, a computer program (i.e., *Pathfinder*) was used to develop a networked representation of concepts and derived the degree to which that network was shared among team members. The cue-contingency task was similar to the measure used in Experiments 2 and 3 of the present effort. The content analysis measure required participants to indicate in their own words the steps teams needed to take to attack and destroy certain objects. Experts rated each report in the team on the action content and the similarity of content across team members. Finally, the concept map required team members to organize, in a grid, a set of 29 behaviors corresponding to the role behaviors of each team member. Each team member had to assign the correct behaviors to a particular team role, and

sequence these role behaviors in the correct order. Marks et al. describes this measure in greater detail.

After arriving at the experimental setting, participants completed informed consent forms, and a background information survey. Each person was then randomly assigned to a role within a team, and each team was randomly assigned to conditions using a counterbalanced design. Team members completed the same training protocol described in Experiment 1. After training, teams (1) completed a performance mission, (2) completed the four mental model measures, and then (3) completed a second performance mission. After the second mission, teams in the rotated condition had their membership completely varied, while teams in the stable condition retained their original membership. Teams then completed another round of mental model measures and the last performance mission.

The analyses of shared mental model measures indicated no significant changes in the sharedness of Time 1 and Time 2 mental models among team members in the rotated team conditions. There also were no significant differences between the mental models of these teams and the corresponding models of team members in the intact teams. These findings suggest that mental model development is particular to the performance context of the team rather than to the idiosyncratic composition of the team.

Correlation analyses of each measure of mental models with team performance at Time 2 for all teams, and at Time 3 for the rotated and intact teams, respectively, indicated that two of the measures, paired comparison ($r = .43$, $p < .05$) and content analysis ($r = .38$, $p < .05$), were associated with team performance in the second mission. However, only the cue contingency measure predicted performance of intact teams on Mission 3, while none of the measures were associated with the performance of rotated teams on this mission. The lack of mental model effects on team performance in the rotated condition suggests that while members may have shared a common mental model of teamwork, this model in a new team context may not have been accurate enough to influence subsequent performance. The findings of this exploratory investigation provide some interesting insights on different types of mental models and the primacy of task context over team membership in developing these models. However, the relatively small sample size requires that these results be treated cautiously, and that future research examine more closely the role of team mental models on team adaptation under different training and performance conditions.

*Research Products*

Kemp, C. F., Wood, G., Cracraft, M., Horn, Z., & Zaccaro, S. J. (2004). *Effects of variability and feedback on team adaptability training*. Presented at the 19th annual meeting of the Society for Industrial and Organizational Psychology, Chicago, IL.

Fleming, P., Wood, G., Ferro, G., Bader, P., & Zaccaro, S. J. (2003*). The locus of shared mental models: Whence does the sharedness come from*? Paper presented at the 18th annual meeting of the Society for Industrial and Organizational Psychology, Orlando, FL.

## *Investigation 4: Developmental Work Experiences and Leader Characteristics—Effects on Tacit Knowledge and Social Competencies as Attributes of Adaptability*

### *Overview and Hypotheses*

This report has described three experiments that examined the (1) influences of feedback as a form of leader communication, and the (b) effects of practice variability as a training design parameter on team adaptation. One objective of this overall research effort was to extend to intact military units and Army leaders the broad research questions regarding adaptability training designs that were examined in laboratory settings; however, the experimental constraints of the requisite designs conflicted with training needs and designs at potential Army training sites. Accordingly, the focus of research with Army officers switched to a consideration of the developmental experiences encountered during the recent track of their careers, and how individual differences such as cognitive complexity and metacognitive skills (see Experiment 1) moderated the impact of these experiences.

Developmental work experiences refer to assignments that challenge the officer's existing skill set and current frames of reference (Lewis & Jacobs, 1992; McCauley et al., 1995; Ohlott, 1998). Because such experiences often entail coping with a variety of novel tasks, they can offer some of the same learning advantages as variability of performance scenarios in formal training settings. To be completed successfully, developmental assignments typically require job incumbents to develop new behavioral repertoires and to expand existing skill sets. They also require the development of more complex frames of reference for understanding and interpreting their operating environment at higher levels of organizational leadership (Lewis & Jacobs, 1992; Zaccaro, 2001). Thus, the successful completion of such assignments should enhance a leader's adaptability skills.

Despite this argument, few studies have examined developmental work experiences as an important tool for growing adaptability skills. Accordingly, the current research effort examined the relationship between developmental assignments and tacit knowledge. Tacit knowledge represents a form of practical intelligence. It is essentially an elaborated mental model that includes integrated cue-contingency relationships (Sternberg, Wagner, Williams, & Horvath, 1995). Thus, it resembles, at a much more complex level, the kinds of strategic mental models participants in Experiments 2 and 3 formed from their experiences in the military simulation. However, tacit knowledge represents organized information "one needs to know to succeed in a given environment, and is knowledge that is typically not explicitly taught and often not even verbalized" (Sternberg, 2002, p. 11). Such knowledge contributes to successful problem solving in ill-defined domains (Wagner, Sternberg, & Okagaki, 1993), and therefore serves as an important basis for individual adaptability. Indeed, Sternberg (2002; pp. 10-11) notes that:

> Intelligence as traditionally defined refers to adaptation to the environment (see e.g., Sternberg & Detterman, 1986). In addition, successful intelligence involves not just adaptation to environments, but a balance among adaptation to environments, shaping of environments, and selection of environments. In particular, adaptation involves changing oneself to suit the environment; shaping involves changing the environment (including people in it) to suit

> oneself; and selection involves finding a new environment….Practical intelligence is that aspect of successful intelligence that is relevant to adaptation, shaping, and selection in everyday life.

Other researchers also have noted the link between tacit knowledge and adaptability. For example, Myers and Davids (1993, p. 124) argued that tacit knowledge can foster a "higher plane of anticipation and flexibility." Thus, growth in tacit knowledge ought to represent a key target for developmental and experiential strategies for growing adaptability skills.

Zaccaro, Gilbert et al. (1991) argued that social intelligence also reflects an important attribute promoting leader adaptability. Such intelligence refers to a set of personal qualities that enable leaders to "(a) perceive and accurately interpret the intricacies of different social situations; (b) derive and select the appropriate behavioral responses that are likely to lead to success for oneself and for others to whom one is beholden, and… (c) enact the selected social responses" (Zaccaro, 2002, p. 38). This suggests that leader adaptability rests in part on the leader's ability to engage in four cognitive and behavioral processes—social awareness, social acumen, response selection, and response enactment (Zaccaro, 2002). Social awareness refers to the leader's detection of key nuances of social dynamics in complex social domains. Social acumen refers to the leader's interpretation of these nuances. Response selection refers to the process of determining and selecting the most appropriate response in a particular social context. Response enactment refers to the leader's effective delivery of selected responses. The present investigation examines social capabilities related to these processes as an outcome of developmental assignments.

Developmental assignments often entail working with different social groups and constituencies, as well as resolving problematic social situations (Ohlott, 1998). As leaders begin to confront assignments that reflect the kinds of problems faced at levels of organizational leadership above their current position, the social complexity of their work can increase dramatically (Zaccaro, 2001). Thus, the successful completion of such assignments ought to contribute to growth in leader social capabilities that will promote adaptability.

Experience does not automatically lead to gains in tacit knowledge. Attributes of the job incumbent completing the assignment will influence how much gain accrues from the experience (Tesluk & Jacobs, 1998). Thus, understanding the influence of developmental assignments on leader tacit knowledge and adaptability requires an integration of particular individual cognitive and dispositional attributes. The present investigation examined four such variables: cognitive complexity, metacognitive skills, tolerance for ambiguity, and openness to experience. The relationships examined and tested in this investigation are shown in Figure 7.

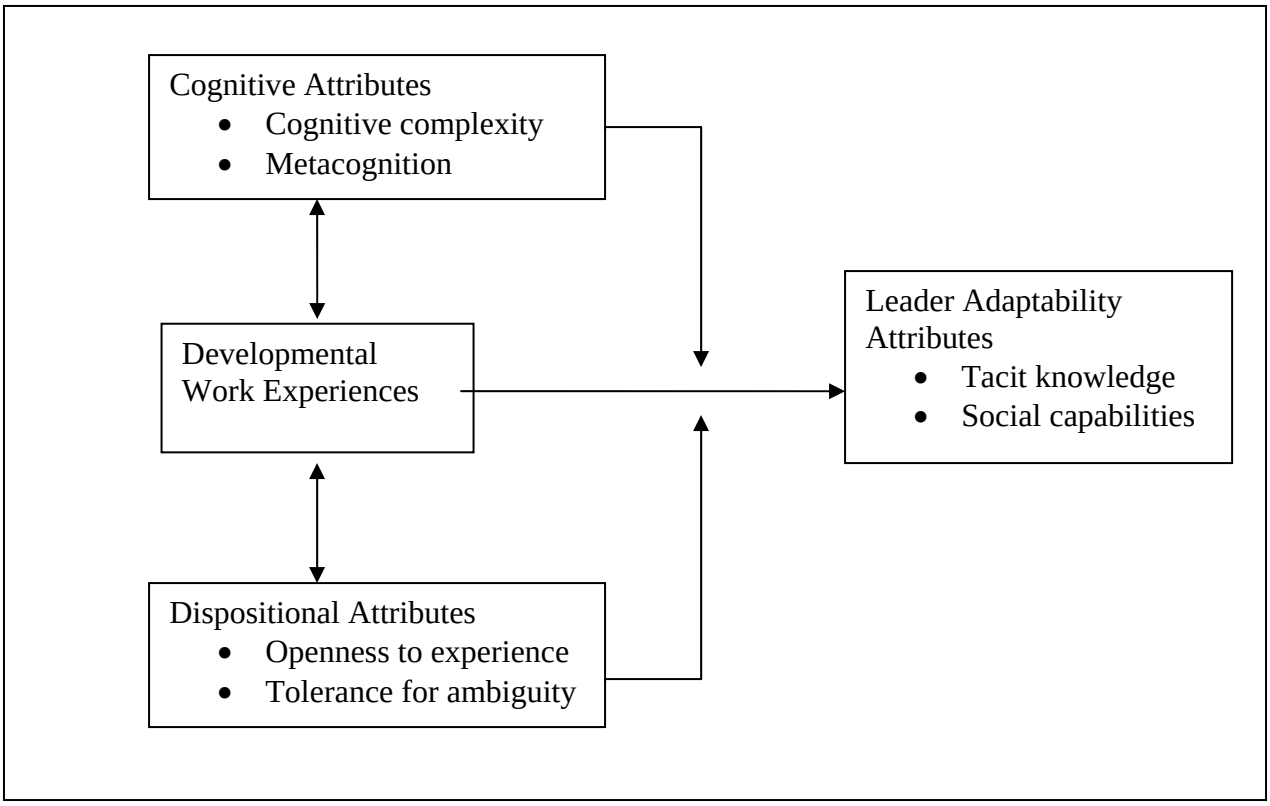


*Figure 7.* Developmental experiences, individual differences, and leader adaptability attributes.

Experiencing challenging work assignments often results in the development of more complex frames of reference (Lewis & Jacobs, 1992). However, such frames of reference are more likely to emerge if participants possess high levels of metacognitive skills and cognitive complexity. Metacognition refers to a process of reflecting upon one's own cognitive and problem solving processes (Davidson et al., 1994; Flavell, 1979). Cognitive complexity refers to an ability to develop more differentiated and integrated mental models and knowledge structures (Streufert & Streufert, 1978; Streufert & Swezey, 1986). Both attributes help individuals derive understanding from developmental work experiences, particularly novel ones. Accordingly, each of these cognitive attributes should moderate the influence of developmental experiences on tacit knowledge and social competencies.

Several personality or dispositional attributes also should moderate the influences of developmental work experiences on learning outcomes. For example, individuals high in openness to experience and tolerance for ambiguity are likely to be more curious and open-minded about novel experiences, and more tolerant of the uncertainty such experiences inherently engender (Barrick & Mount, 1991; McCrae & Costa, 1987). Indeed, Judge et al. (1999) found that tolerance for ambiguity was positively associated with individuals' ability to cope with change. Accordingly, in the present investigation, the attributes of openness to experience and tolerance for ambiguity were predicted to influence the degree to which developmental experiences resulted in growth in tacit knowledge and social competencies.

*Method*

*Participants.* The participants in this research included 150 senior-level military officers (Lieutenant Colonel and Colonel) and civilian government leaders (GS-14/15) who were attending the U.S. Army War College (AWC).

*Measures.* Leader tacit knowledge was assessed using the *Tacit Knowledge for Military Leaders: Battalion Commander Questionnaire* (Hedlund, Forsythe, Horvath, Williams, Snook, & Sternberg, 2003). Respondents were presented with nine military workplace scenarios and asked to rate the appropriateness of particular responses to each one. Tacit knowledge scores were derived from the differences between the participant ratings of the available responses and a mean expert rating. These scores were then corrected for variability in expert responses and reversed for ease of interpretability. Reported internal consistencies are approximately .68.

Measures of four attributes—empathy, social intelligence, self-monitoring, and communicative competence—were used to assess social competency. Empathy was assessed with the 10-item Empathetic Person Scale (Hogan, 1969). Social intelligence was assessed with a 41-item background data measure (Zaccaro, Zazanis, et al., 1995). Self-monitoring was assessed with a 13-item scale from Lennox and Wolfe (1984). Finally, competence in communication was assessed with a 30-item scale from Weimann (1977). A total social competency index was created by converting scores on each measure into Z-scores and then averaged into a combined score.

The officers' experience of challenging work assignments was assessed using the Job Challenge Profile (JCP; McCauley, Ohlott, & Ruderman, 1989). The measure contains 50 items that are grouped into five major dimensions described earlier in this report. The original measure was developed in a corporate setting and, therefore, was altered for the present investigation in 2 ways. First, a number of the items were adapted to conform to a military sample. Second, respondents were asked to report the degree to which they have experienced particular types of challenges across their career as opposed to just within their current position.

Work experience scores were derived for each of the subscales on the measure. These scores also were combined to create a total score. In addition, indicators of *diversity* of challenging experiences were calculated by totaling the frequency of assignments respondents indicated as experiencing at more than minimal levels.

Four measures of individual differences were examined in this investigation: (1) metacognition, (2) cognitive complexity, (3) openness to experience, and (4) tolerance of ambiguity. Metacognition was assessed with a 12-item scale from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1993). Cognitive complexity was measured with the 28-item Attributional Complexity Scale (Fletcher, Danilovics, Fernandez, Peterson, & Reeder, 1986). This scale also contained a 4-item subscale used to assess metacognition; this subscale was used as a second assessment of that attribute. A subscale from Saucier's (1994) measure of personality was used to assess openness to experience. Tolerance of ambiguity was assessed with the Multiple Stimulus Types Ambiguity Tolerance Scale (McLain, 1993).

*Procedure*. The research was announced to participants at AWC, and they volunteered to complete the battery of measures in exchange for a normative feedback session. Packets were distributed to participants, who were asked not to discuss the measures or their answers with anyone else. They returned the completed surveys a week after receiving them.

*Summary of Results*

Table 6 presents the descriptive statistics and correlations for this investigation. Moderated regression analyses were completed on proposed predictors of tacit knowledge and social competencies, respectively. Separate regression analyses were completed for each of the individual difference variables and each of the three parameters of work experiences. A more detailed summary of the results of these analyses is shown in Appendix A. These analyses indicated that:

- The effects of challenging assignments on tacit knowledge were moderated by cognitive complexity, metacognitive skill (as measured by the subscale of the Attributional Complexity Scale), and, marginally, by openness to experience. More specifically, the relationship between challenging assignments and tacit knowledge was more strongly positive when officers possessed higher levels of cognitive complexity and metacognitive skills, and higher openness to experience.
- The effects of diversity of Fexperience on tacit knowledge were moderated marginally by tolerance for ambiguity. For officers with higher tolerance for ambiguity, diversity of experience was more positively associated with gains in tacit knowledge.
- The challenge and diversity of developmental experiences had a direct and positive influence on social capabilities.
- The effects of challenging experiences on social competencies were moderated by metacognition, as assessed on the Attributional Complexity Scale. As with tacit knowledge, metacognitive skills produced stronger, more positive relationships between experiences and social competencies.
- The effects of diversity of assignment on social competencies were moderated by both measures of metacognition and tolerance for ambiguity, and – marginally – by cognitive complexity. For officers with higher metacognitive skills, higher tolerance for ambiguity, and higher cognitive complexity, assignment diversity was more strongly and positively related to social competences.

*Discussion*

The results of this investigation support the premise that challenging work experiences foster growth in particular attributes that, in turn, are likely to facilitate leader adaptability. Such experiences had a direct effect on social competence variables. The influence of job challenge on tacit knowledge and social competencies was moderated in part by an officer's level of cognitive complexity. Cognitive complexity refers to an ability to develop fine-grained distinctions and integrations among concepts and to organize them into a comprehensive frame of reference (Fletcher et al., 1986; Streufert & Streufert, 1978). Such ability allows officers to draw a broader

array of lessons from their varied experiences, and use these lessons to revise and expand their cognitive representations of their operating environment.

Table 6

*Descriptive Statistics and Correlations—Investigation 4*

| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Metacognition | 4.63 | .84 | (.82) | | | | | | | | | | | | | | | | | | | |
| 2. Cognitive Complexity | 4.78 | .72 | **.50** | (.91) | | | | | | | | | | | | | | | | | | |
| 3. Metacognitive Subscale | 5.14 | .91 | **.45** | **.84** | (.74) | | | | | | | | | | | | | | | | | |
| 4. Tolerance for Ambiguity | 4.88 | .77 | **.37** | **.27** | **.33** | (.89) | | | | | | | | | | | | | | | | |
| 5. Openness | 6.56 | 1.00 | **.43** | **.37** | **.35** | **.57** | (.80) | | | | | | | | | | | | | | | |
| 6. Unfamiliar Responsibilities (JT) | 2.25 | .52 | .05 | .06 | .15 | .11 | .12 | (.65) | | | | | | | | | | | | | | |
| 7. New Directions (CC) | 2.63 | .69 | **.26** | **.29** | **.27** | **.29** | **.33** | **.29** | (.74) | | | | | | | | | | | | | |
| 8. Inherited Problems (CC) | 2.14 | .59 | **.22** | **.32** | **.28** | .15 | **.18** | **.31** | **.61** | (.78) | | | | | | | | | | | | |
| 9. Problems with Employees (CC) | 2.23 | .54 | **.24** | **.29** | **.33** | **.17** | **.18** | **.29** | **.50** | **.62** | (.76) | | | | | | | | | | | |
| 10. High Stakes (HLR) | 3.29 | .66 | **.18** | **.24** | **.21** | **.20** | **.24** | **.23** | **.47** | **.43** | **.40** | (.67) | | | | | | | | | | |
| 11. Scope and Scale (HLR) | 2.98 | .64 | **.24** | **.22** | **.19** | **.34** | **.37** | .32 | **.66** | **.50** | **.40** | **.53** | (.68) | | | | | | | | | |
| 12. External Pressure (MB) | 2.54 | .79 | **.17** | **.20** | .16 | **.28** | **.25** | **.34** | **.52** | **.37** | **.19** | **.44** | **.58** | (.81) | | | | | | | | |
| 13. Influence w/o Authority (MB) | 3.09 | .67 | **.27** | **.33** | **.33** | **.29** | **.34** | **.34** | **.51** | **.35** | **.34** | **.48** | **.47** | **.60** | (.69) | | | | | | | |
| 14. Work Across Cultures (DD) | 2.47 | .79 | **.17** | **.24** | **.25** | **.29** | **.19** | .13 | **.29** | .13 | .07 | .16 | .40 | **.55** | **.39** | (.82) | | | | | | |
| 15. Work Group Diversity (DD) | 3.30 | .91 | .13 | **.26** | **.28** | .13 | .08 | .15 | **.37** | **.34** | **.37** | **.38** | **.44** | .27 | **.33** | **.29** | (.73) | | | | | |
| 16. Total Challenging Assignments | 2.68 | .45 | **.29** | **.37** | **.37** | **.34** | **.35** | **.48** | **.78** | **.68** | **.59** | **.68** | **.80** | **.75** | **.73** | **.55** | **.60** | (.92) | | | | |
| 17. Diversity of Experience 1 | 4.66 | 2.68 | **.29** | **.37** | **.39** | **.36** | **.33** | **.48** | **.70** | **.64** | **.58** | **.63** | **.71** | **.63** | **.66** | **.48** | **.57** | **.91** | - | | | |
| 18. Diversity of Experience 2 | 1.65 | 2.06 | **.28** | **.33** | **.34** | **.25** | **.26** | **.50** | **.66** | **.64** | **.57** | **.60** | **.63** | **.65** | **.65** | **.41** | **.41** | **.85** | **.75** | - | | |
| 19. Tacit Knowledge | 1.98 | .83 | .13 | -.02 | -.05 | -.07 | .03 | -.02 | .15 | .02 | .03 | -.01 | .04 | .04 | .07 | -.11 | -.12 | .01 | .01 | .05 | (.83) | |
| 20. Social Competencies | -.01 | .82 | **.46** | **.53** | **.47** | **.40** | **.39** | -.02 | **.30** | **.29** | .15 | .14 | **.29** | **.20** | **.26** | **.17** | **.23** | **.31** | **.32** | **.31** | .10 | (.93) |

*Note.* Coefficient alphas are provided on the diagonal.
**Bold** typeface indicates $p < .05$.
Challenging Work Assignments Dimensions: JT = Job Transitions; CC = Creating Change; HLR = Managing at High Levels of Responsibility; MB = Managing Boundaries; DD = Dealing with Diversity.

Tacit knowledge appeared to be affected primarily by the degree of challenge in the officers' developmental assignments. Diversity of experiences had only marginal influences on tacit knowledge. However, experiential diversity exhibited significant direct effects on social competencies: more experiential diversity was associated with higher levels of these capabilities. Such diversity refers to the breadth and variety of developmental assignments experienced by the officer. Different kinds of assignments may present various kinds of social interactions, social dynamics, and social challenges to officers. The experiences with such different constituencies should foster growth in social capabilities. As such, experiential diversity reflects a much more complex form of scenario variability found to be related to team adaptability in Experiment 3.

The effects of diversity were even stronger for officers who possessed metacognitive skills and tolerance for ambiguity. Metacognitive skills refer to an ability to reflect upon and regulate one's cognitive processes (Brown, 1978; Pintrich et al., 1993 Sternberg, 1985, 1988). Metacognitive thinking skills contribute to leaders' social reasoning abilities by regulating their application in social problem solving. Metacognitive skills help leaders evaluate their own social perception processes and the interpretations they apply to the kinds of social information acquired from the diversity of developmental experiences. Such metacognitive thinking also facilitates a leader's understanding of how different social constituencies, encountered across a diversity of assignments, perceive his or her leadership actions. This form of metacognition has been labeled "metaperception," and has been defined as the awareness and understanding one has of how others perceive and evaluate oneself (Shectman & Kenny, 1994). Accuracy in metaperception is important for leaders to determine the degree of social and organization support that can be engendered for their decisions and actions. There is little prior research on the importance of metacognitive and metaperceptual capabilities for socially intelligent behavior. The results of this investigation suggest that one contribution of these skills is to help the leader derive lessons and understanding from the more complex social dynamics engendered by the diversity of experienced developmental assignments.

This research used a survey method, collecting data from all participants at a single point in time. Accordingly, causal priority needs to be regarded as a significant caveat in interpreting the results of this investigation. A central issue regarding the research questions investigated here pertains to whether developmental assignments cause growth in personal adaptability attributes, or whether officers with high levels of these attributes are more likely to garner, or seek out, these assignments (cf. Tesluk & Jacobs, 1998). Examining this issue would require a longitudinal approach to developmental assignments and individual differences.

Taken together, these results indicate the importance of developmental experiences as a strategy for developing leader adaptability skills. This research also extends two general themes from the laboratory experiments. The interactions of developmental assignments and cognitive skills can be construed as similar to the aptitude by treatment interaction observed in Experiment 1. In that investigation, higher metacognitive skills increased the influence of team-oriented process feedback on team adaptation. In Investigation 4, higher metacognitive skills and cognitive complexity increased the influence of developmental assignments on attributes that promote leader adaptability. Also, as noted, the effects of experiential diversity observed in this investigation resemble, at a conceptual level, the findings from Experiment 3 on practice

scenario variability. Thus, this survey of current Army leaders has yielded results broadly congruent with findings from the more controlled experiments with college students.

*Research Products*

Banks, D., Bader, P., Fleming, P., Zaccaro, S. J., & Barber, H. (2001). *Leader adaptability: The role of work experiences and individual differences*. Paper presented at the 16th annual meeting of the Society for Industrial and Organizational Psychology, San Diego, CA.

Zaccaro, S. J. and Banks, D. (2002). *Developmental experiences and growing leadership: Theoretical and empirical perspectives.* Symposium presented at the 17th annual meeting of the Society for Industrial and Organizational Psychology, Toronto, Canada.

### *Investigation 5: Developmental Work Experiences and Leader Characteristics—Effects on Tacit Knowledge and Social Competencies as Attributes of Adaptability, A Replication*

*Summary*

A second opportunity arose in this research effort to collect data from another, later sample of Army War College students. Participants in this investigation included 72 senior level military officers (Lieutenant Colonel and Colonel) and government managers (GS 14/15). The measurement battery administered in this investigation was essentially the same as the one distributed in Investigation 4, with the exception that some measures (e.g., empathy) were excluded to reduce survey time. Also, while paper copies of the survey battery were distributed to participants and returned to a central location in Investigation 4, participants in this investigation completed a web-based assessment battery. This procedural change may have been partly responsible for the smaller number of volunteer subjects for this investigation as opposed to Investigation 4.

While the assessment battery contained the revised Job Challenge Profile (McCauley et al., 1989), the subscales were grouped based on a determination of whether a particular assignment represented "informationally complex" work (e.g., unfamiliar responsibilities, new directions, high stakes, scope and scale) or "socially complex" work (e.g., problems with employees, external pressures, influence without authority, work across cultures, and work group diversity). It was hypothesized that informationally complex assignments would be more strongly related to cognitive attributes and tacit knowledge than socially complex assignments, while the latter would be more strongly related to social competencies.

The results of moderated regressions, shown in Appendix B, partially replicated the findings of Investigation 4. The effects of job challenge and breadth or diversity of experiences on tacit knowledge was marginally moderated by officers' levels of tolerance for ambiguity and openness to experience. As in Investigation 4, stronger relationships between characteristics of development assignments and tacit knowledge were observed in officers with higher ambiguity tolerance. Surprisingly, openness to experience indicated the opposite effect: higher levels of openness resulted in attenuated relationships. Unlike Investigation 4, the results of analyses of

developmental assignments and tacit knowledge indicated no significant direct effects or interactions with cognitive attributes.

Bivariate correlations, shown in Table 7, indicated high correlations among the job challenge dimensions, making it difficult to statistically disentangle their effects. Thus, while all of the regression analyses indicated significant amounts of variance explained by the entire set of job challenge dimensions, the indicated regression coefficients for each of the two proposed subsets of assignments were not significant, suggesting the effects of multicollinearity, exacerbated by the relatively small sample size. However, socially complex work experiences did display a unique and stronger relationship than informationally complex assignments with social intelligence and self monitoring skills. The overall significant positive relationship between complex job assignments and social competencies replicates another finding from Investigation 4.

The major difference between the findings of Investigation 4 and those of Investigation 5 was the failure of cognitive attributes to moderate the influence of job challenge on tacit knowledge. This may be due to the smaller sample size in this investigation (approximately 50% fewer participants than in Investigation 4), reducing the power to detect what may be a small effect size.

*Research Products*

Bader, P., Fleming, P. J., Zaccaro, S. J., & Barber, H. F. (2002). *The effects of developmental work experiences on adaptability*. Presented at the 17th annual meeting of the Society for Industrial and Organizational Psychology, Toronto, Canada.

Table 7

*Descriptive Statistics and Correlations—Investigation 5*

| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Metacognition | 3.41 | .45 | (.72) | | | | | | | | | | | | | | | | | | | |
| 2. Cognitive Complexity | 3.62 | .44 | **.54** | (.89) | | | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 3. Tolerance for Ambiguity | 3.56 | .45 | **.48** | **.33** | (.90) | | | | | | | | | | | | | | | | | |
| 4. Openness | 3.81 | .63 | **.47** | **.51** | **.34** | (.86) | | | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 5. Social Intelligence | 3.44 | .35 | **.42** | **.48** | **.43** | **.39** | (.91) | | | | | | | | | | | | | | | |
| 6. Self-Monitoring | 3.05 | .61 | **.32** | **.25** | **.43** | **.30** | **.72** | (.87) | | | | | | | | | | | | | | |
| 7. Communicative Competence | 3.88 | .34 | **.35** | **.34** | **.37** | .23 | **.61** | **.60** | (.88) | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 8. Unfamiliar Responsibilities | 2.26 | .52 | .16 | .27 | .13 | .13 | .22 | **.28** | -.02 | (.68) | | | | | | | | | | | | |
| 9. New Directions (CC) | 2.90 | .73 | **.36** | **.36** | **.43** | **.27** | **.47** | **.39** | .25 | **.49** | (.82) | | | | | | | | | | | |
| 10. Inherited Problems (CC) | 2.31 | .62 | .19 | .07 | **.29** | .14 | .22 | .25 | .09 | **.37** | **.53** | (.83) | | | | | | | | | | |
| 11. Problems with Employees | 2.26 | .45 | **.26** | .18 | **.34** | .16 | **.26** | .40 | -.03 | **.47** | **.42** | **.63** | (.65) | | | | | | | | | |
| 12. High Stakes (HLR) | 3.45 | .66 | **.43** | **.27** | **.41** | **.38** | **.54** | **.55** | **.28** | **.48** | **.58** | **.52** | **.51** | (.72) | | | | | | | | |
| 13. Scope and Scale (HLR) | 3.17 | .64 | **.40** | .23 | **.29** | .24 | **.42** | **.45** | .23 | **.53** | **.52** | **.52** | **.48** | **.79** | (.71) | | | | | | | |
| 14. External Pressure (MB) | 2.93 | .80 | **.34** | **.31** | **.31** | **.37** | **.42** | **.43** | .22 | **.29** | **.52** | **.39** | **.28** | **.47** | **.39** | (.81) | | | | | | |
| 15. Influence w/o Authority (MB) | 3.19 | .69 | **.38** | **.37** | **.43** | **.42** | **.52** | **.51** | **.35** | **.38** | **.55** | **.44** | **.35** | **.66** | **.53** | **.68** | (.77) | | | | | |
| 16. Work Across Cultures (DD) | 2.57 | .68 | .21 | .19 | .18 | .15 | **.38** | **.38** | **.31** | .21 | **.45** | .30 | .16 | **.45** | **.37** | **.38** | **.43** | (.73) | | | | |
| 17. Work Group Diversity (DD) | 3.60 | .75 | .24 | .23 | .23 | .21 | **.38** | .23 | .12 | .18 | **.51** | **.39** | **.30** | **.46** | **.44** | **.31** | **.40** | **.35** | (.71) | | | |
| 18. Total Challenging | 2.85 | .46 | **.43** | **.36** | **.43** | **.36** | **.56** | **.55** | **.27** | **.60** | **.80** | **.71** | **.62** | **.84** | **.78** | **.70** | **.79** | **.60** | **.62** | (.88) | | |
| 19. Breadth of Experience | 5.60 | 2.8 | **.46** | **.31** | **.45** | .24 | **.50** | **.55** | **.27** | **.50** | **.69** | **.67** | **.61** | **.73** | **.74** | **.50** | **.68** | **.50** | **.62** | **.91** | * | |
| | | | | | | | | | | | | | | | | | | | | | | |
| 20. Tacit Knowledge | .787 | .14 | -.03 | -.04 | -.15 | -.01 | .13 | .16 | .20 | .13 | -.03 | .10 | .05 | -.05 | -.07 | .11 | -.04 | -.05 | -.07 | .01 | -.04 | (.79) |

*Note.* *This variable is made up of dichotomous items. Coefficient alphas are provided on the diagonal.
**Bold** typeface indicates $p < .05$.
00Challenging Work Assignments Dimensions: JT = Job Transitions; CC = Creating Change; HLR = Managing at High Levels of Responsibility; MB = Managing Boundaries; DD = Dealing with Diversity.

*Investigation 6: Developmental Assignments, Leader Characteristics, and Organizational Context—Effects on Leader Adaptability*

Note: A full description of this experiment and its findings are provided in the following source:

Banks, D. J. (2006). *Stretch experiences and leader development: The relationships among work experience, individual differences, contextual variables and leader adaptability*. Dissertation Abstracts International: Section B: The Sciences and Engineering, Vol. 67(6-B), 2006. p. 3493.

*Overview and Hypotheses*

Investigation 6 expanded in several ways the research questions about developmental work experiences addressed in Investigations 4 and 5. First, learning goal orientation was included in the set of individual differences proposed as moderating the effects of such experiences (openness to experience was excluded from this investigation to conserve survey time, and because the effects observed in prior investigations were weak and contradictory). Dweck (1989) proposed that individuals in a learning situation can possess either a performance goal orientation or a learning goal orientation. Performance goal orientation reflects a preference for demonstrating competence and success, while learning goal orientation reflects a larger concern with mastery and gaining new skills. A learning goal orientation increases the likelihood that individuals will seek challenging and novel assignments (Nicholls, 1984; Tesluk, Dragoni, & Russell, 2002). However, the higher likelihood of failure in these situations means that individuals with a performance goal orientation will be less likely to select or be motivated by such assignments. Tesluk et al. (2002) found that learning goal orientation was positively associated with observed gains from developmental assignments. The present investigation examines the degree to which learning goal orientation moderates the effects of developmental assignments on tacit knowledge and social competencies.

This investigation also extends Investigations 4 and 5 by testing the proposed link of social competencies to leader adaptability. These prior investigations assumed this relationship, using social competencies in dynamic social contexts as a surrogate for or a key component of leader adaptability. This investigation directly tests this proposition.[1] Also, this investigation examines the hypothesis that the effects of social competencies on adaptive performance will be moderated by perceived support for innovation in the organizational context. Tesluk and Jacobs (1998) argued that contextual variables will constrain or enhance the extent to which learning from developmental assignments translates to displayed gains in performance. Adaptive performance often requires novel actions and decisions on the part of the adapting leader.

[1]This study also examined tacit knowledge as a mediator of the relationship between developmental experiences and adaptability. The instrument used to measure such knowledge was the Tacit Knowledge for Managers (Wagner & Sternberg, 1985). This measure is scored using a consensus-based measure, where the mean answer among participants is used as the "correct" response. However, the present sample contained a significant number of lower and middle level managers, setting their responses as the scoring norm for the entire sample of managers. Consequently, this measure yielded counterintuitive significant correlations with age (-.24), job tenure (-.25), number of positions in different organizations (-.48), tolerance for ambiguity (-60), and metacognitive skill (-.43). Accordingly, we did not include this measure in the analyses summarized in this report. See Banks (2006) for a full summary of all analyses.

However, if the organizational climate does not encourage such innovation, then leader adaptability attributes, such as social competencies, are less likely to result in displayed adaptive performance (Amabile, 1988; Amabile & Gryskiewicz, 1989; Scott & Bruce, 1994). Figure 9 illustrates the conceptual model and hypothesized relationships tested in this investigation.

*Method*

*Participants.* The participants in this investigation included 64 female and 56 male business managers at the lower (9.6 %), middle (64.4 %), and upper (26.0 %) levels of seven organizations. These organizations were variable in geographic location, size, and industry sector.

*Measures.* Social competencies were assessed using the background data measure of social intelligence, the revised self-monitoring scale, and communicative competence scales also used in Investigations 4 and 5. Again, Z-scores were calculated for each of these three indicators and averaged to create a total social competencies score.

The degree to which managers experienced challenging work assignments during their career was assessed using the Job Challenge Profile (JCP; McCauley et al., 1989). Recall that this measure was revised for use with military officers in Investigations 4 & 5. The original version of the JCP, written for business managers, was used in this investigation.

The measures of metacognition, cognitive complexity, and tolerance for ambiguity used in the earlier investigations of this research effort were included in this investigation. In addition, respondents completed VandeWalle's (1997) goal orientation measure. A subscale of that measure was used as an index of learning goal orientation in the analyses for Investigation 6. All of the predictor measures in the present data set yielded acceptable internal consistencies ranging from .72 to .89.

Perceived support for innovation was assessed with subscales (support for creativity and tolerance of differences) from Siegel and Kaemmerer's (1978) Support for Innovation scale. These scales ask respondents to evaluate the innovation climate of their organization. The internal consistency of the measure in the present investigation was $\alpha = .87$.

Leader adaptive performance was assessed through ratings by participants' supervisors on a set of behaviorally anchored 7-point rating scales (e.g., Pulakos et al., 2002) based on the eight dimensions described by Pulakos et al. (2000). This set contained only the dimensions found to be particularly related to managerial positions, including (1) demonstrating interpersonal adaptability; (2) dealing effectively with unpredictable or changing work situations; (3) learning work tasks, technologies, and procedures; (4) displaying cultural adaptability; and (5) solving problems creatively. This set of behaviorally anchored rating scales (BARS) also contained a scale asking raters to evaluate their subordinate's overall level of adaptation.

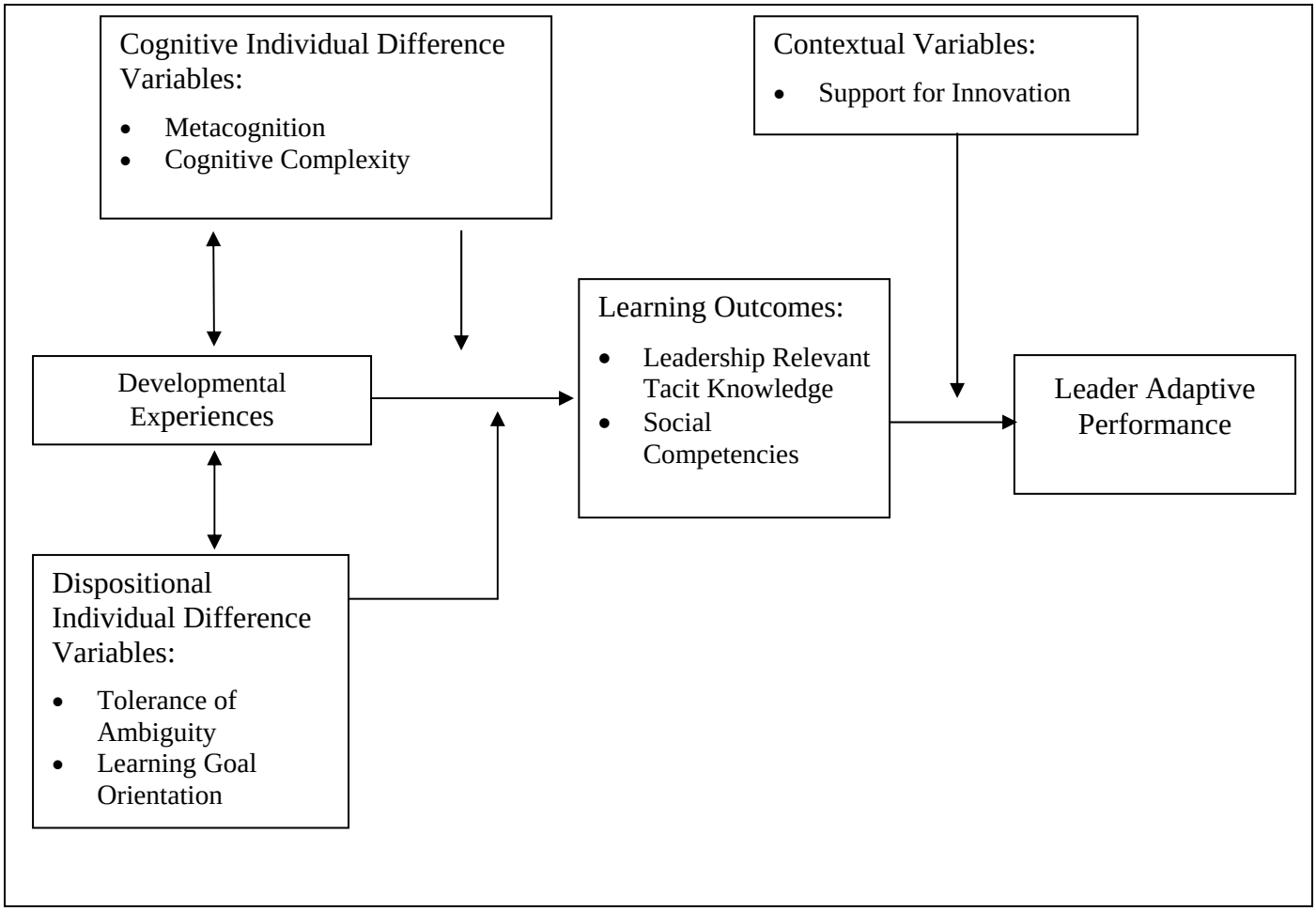


*Figure 8.* Theoretical model of variables in Investigation 6 (from Banks, 2006).

*Procedure*. Participants were informed of the research and those who agreed to participate received the measurements packets with a request to return them in one week's time. They also received five copies of the BAR scales and were asked to distribute them to their supervisor, to two peers, and to two direct reports. The raters also were asked to return their assessments in a week's time. For this investigation, only the supervisor ratings were used as the criteria.

*Summary of Results*

Descriptive statistics and correlations for all of the variables in this investigation are shown in Table 8. Moderated regression analyses were completed on the aggregated social competency scores. As expected, tolerance for ambiguity ($\Delta R^2 = .19$, $p < .05$), metacognitive skill ($\Delta R^2 = .20$, $p < .05$), and cognitive complexity ($\Delta R^2 = .03$, $p < .05$) each moderated the influence of developmental work assignments on social competency. Leaders with higher levels of these attributes exhibited stronger relationships between assignments and social competency. Learning goal orientation did not moderate this relationship. Illustrations of the interactions found in this investigation are contained in Appendix C.

A moderated regression analysis also was completed on supervisor ratings of leader adaptability, with social competencies as a predictor and perceived support for innovation as a moderator. The results of this analysis supported the hypothesis that the influences of this individual attribute on leader adaptive performance depended upon the amount of support for innovation in the organizational context. As expected, social competencies ($\Delta R^2 = .11$, $p < .05$) resulted in higher ratings of adaptive performance by the leader's supervisors when the climate of the organization was reported as being conducive to innovation by its leaders. An illustration of this interaction is contained in Appendix C.

*Discussion*

Investigation 6 builds upon the findings of Investigations 4 and 5 in several ways. First, as in the previous investigations, individual differences moderated the effects of developmental work experiences and social competences. Investigation 6 replicated, at a general level, the effects of tolerance for ambiguity, metacognitive skills, and cognitive complexity found earlier. While the strength and particular contribution of each has varied across the organizational settings and samples, the overall pattern supports the importance of these particular dispositional variables in fostering the effects of developmental assignments on the growth of social competencies.

Investigation 6 also demonstrated empirically the link between social competencies and leader adaptive performance. While some prior research has found influences of social capabilities on leadership (see reviews by Zaccaro, 2001, 2002; Zaccaro, Gilbert, et al., 1991), few if any studies have explicitly examined how such abilities contribute to adaptive performance by the leader. The results of the present investigation affirm this link more directly. However—and more importantly—this investigation also indicates the critical moderating role of perceived organizational context. Personal attributes that predict leader adaptation will do so primarily in organizations where the innovation often required for adaptation is permitted and, indeed, encouraged.

These findings, together with the results of Investigations 4 and 5, provide an important research base for the consideration of developmental assignments as a key tool in promoting leader adaptability skills. Operational assignments represent one of the three key pillars of leader development in the Army (Sullivan, 1999; U.S. Department of the Army, 2006). However, these assignments are more likely viewed as "stamping-in" experiences, intended to make routine newly acquired knowledge and skills (cf. Zaccaro & Banks, 2004). The Army has become increasingly concerned about developing adaptive Soldiers and leaders to fight on today's more unconventional battlefield. The findings of these three investigations point to the criticality of developmental assignments as part of the leader development tool kit employed to grow such skills. Future research will need to investigate the particular parameters of developmental assignments that are most likely to result in faster and more efficient accrual of adaptability skills. Also, future studies need to investigate more closely how organizational context variables, particularly in the Army, moderate the influences of developmental assignments on leadership learning.

Table 8
*Descriptive Statistics and Correlations—Investigation 6*

| | | *M* | *SD* | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. | Age | 37.02 | 7.81 | | | | | | | | | | | | |
| 2. | Leadership Experience | 7.32 | 7.16 | **.85** | | | | | | | | | | | |
| 3. | Tenure with Current Org | 6.61 | 5.04 | **.33** | **.30** | | | | | | | | | | |
| 4. | Tenure in Current Position | 2.35 | 1.43 | **.29** | **.38** | -.16 | | | | | | | | | |
| 5. | Number of Organizations | 3.41 | 1.75 | **.54** | **.46** | **-.32** | **-.31** | | | | | | | | |
| 6. | Stretch Assignments | 2.96 | .49 | **.30** | **.22** | -.03 | .00 | **.23** | | | | | | | |
| 7. | Tolerance of Ambiguity | 3.63 | .35 | .07 | -.01 | -.10 | **.25** | **.33** | -.14 | | | | | | |
| 8. | Learning Goal Orientation | 4.27 | .46 | .12 | -.12 | **.33** | .03 | -.15 | **.51** | .11 | | | | | |
| 9. | Metacognition | 3.44 | .35 | **.27** | .14 | **-.22** | **.40** | **.28** | .13 | **.39** | **.42** | | | | |
| 10. | Cognitive Complexity | 3.65 | .40 | **.27** | .18 | **.39** | -.09 | **-.24** | .05 | -.12 | **.22** | -.07 | | | |
| 11. | Social Competencies | 0.00 | .82 | -.02 | -.17 | .03 | .05 | -.08 | **.42** | .17 | **.39** | **.37** | **.42** | | |
| 12. | Support for Innovation | 3.58 | .42 | -.04 | .00 | **.27** | -.14 | **-.56** | .20 | -.12 | **.21** | -.01 | .14 | **.19** | |
| 13. | Leader Adaptability (Supervisor Ratings) | 4.83 | .95 | -.06 | .01 | .04 | .19 | **-.34** | **.28** | .02 | -.01 | **.35** | **.43** | **.25** | **.35** |

*Note*. **Bold** typeface indicates $p < .05$. From Banks (2006).

*Research Products*

Banks, D. J. (2006). Stretch experiences and leader development: The relationships among work experience, individual differences, contextual variables and leader adaptability. *Dissertation Abstracts International: Section B: The Sciences and Engineering*, Vol. *67*(6-B), 2006. pp. 3493.

Banks, D. J., & Zaccaro, S. J., (2004). *Developmental work experiences and stretch assignments: Providing pathways for growing today's leaders*. Paper presented at the 19th annual meeting of the Society for Industrial and Organizational Psychology, Chicago, IL.

Zaccaro, S. J., & Banks, D. J. (2004). *Developmental work assignments for middle and upper level organizational leaders*. Paper presented at the 19th annual meeting of the Society for Industrial and Organizational Psychology, Chicago, IL.

## *Investigation 7: Predicting Leader Adaptability With Leader Trait Patterns–1*

*Overview and Hypotheses*

A final objective of this research effort was to investigate leader attributes proposed as contributing to adaptive performance. Zaccaro (2001) argued that effective leadership emerges from combinations of cognitive, social, and dispositional qualities of the leader. Accordingly, a pattern-attribute approach (Smith & Foti, 1998) was necessary to understand how leader traits and individual differences influence leadership effectiveness. Table 1 lists a number of the attributes proposed to foster effective leader adaptation. Several of the investigations described thus far in this report have provided nomological and criterion-related validity for some of these constructs. Nomological validity refers to the degree to which the targeted attributes are related to measures of other constructs in hypothesized ways. According to Messick (1989, p. 48):

> The basic notion of nomological validity is that the theory of the construct being measured provides a rational basis for deriving empirically testable links between the test scores and measures of other constructs. It is not that a proven theory serves to validate the test, or vice versa. Rather the test gains credence to the extent that score consistencies reflect theoretical implications of the construct, while the construct theory gains credence to the extent that test data jibe with its predictions.

Investigations 1 and 4-6 provided support for hypothesized cognitive and dispositional moderators of key predictors of individual and team adaptation. Also, Investigation 6 demonstrated the predictive validity of social competencies on adaptability, albeit under conditions of high perceived support for innovation. Thus, as a set, the research investigations described up to this point in this report have contributed some evidence for the utility of the proposed constructs in Table 1 as part of a nomological network of attributes predicting adaptation.

The intent of Investigation 7 was to examine how proposed leader adaptability attributes are related independently and jointly to measures of leader adaptability. Specifically, this research tested the effects of metacognitive skill, emotional intelligence, and optimism on ratings of adaptability during a business simulation game requiring participants to adapt to a major change event.

Based on the pattern trait perspective, adaptability should be higher in managers who have high levels of all three skills. This HHH combination should be significantly different from all other combination of attributions. Likewise, the remaining combinations will not be significantly different from one another in their prediction of adaptability.

*Method*

*Participants.* Participants included 142 middle- to upper-level managers attending one of several week-long leadership development programs. One hundred and three of these participants provided ratings on all of the measures in the research. The sample was largely male (71%) and Caucasian (87%). The average age of the participants was 40 years, ranging from 30-58 years.

Each leader development program included a role-play simulation in which approximately 21 individuals enacted organizational positions ranging from plant manager to president of a simulated business. Their task was to consider and make a series of strategic and operational decisions in the running of an organization. However, in the middle of the simulation, a dramatic change occurred that required participants to adapt their strategic plans. After this change, the leadership adaptability displayed by each participant was observed and assessed for approximately 2.5 hours.

*Measures*. Metacognition was assessed with a subscale from the Motivated Strategies for Learning Questionnaire (MSLQ; Pintrich et al., 1993). Emotional intelligence was measured by the 133-item BarOn Emotional Quotient Inventory (EQ-i) (Bar-On, 1997). The measure contains 16 subscales (Self-Regard, Emotional Self-Awareness, Assertiveness, Independence, Self-Actualization, Empathy, Social Responsibility, Interpersonal Relationships, Reality Testing, Flexibility, Problem Solving, Stress Tolerance, Impulse Control, Optimism, and Happiness). It also has items used to adjust ("deflate" or "inflate") scale and subscale scores to correct for overly positive or overly negative self-presentations. Optimism was assessed with the 12-item Life Orientation Test (LOT) (Scheier & Carver, 1985). According to Chang (2001), "this measure provides the most direct assessment of optimism and pessimism as we commonly understand them" (p. 6).

Ratings of leader adaptability after the change event were provided on a series of behaviorally anchored rating scale (BARS) developed for this investigation. The BARS were based upon the leader adaptability processes described earlier in this report. The scale anchors were developed from interviews with individuals and focus groups connected to the organization that sponsors and delivers the program. Ratings were made on a 7-point Likert scale ranging from *below average* to *exceptional*.

Trainers from the leadership development program and researchers from the research team rated the leader adaptability of the participants. Each rater was trained to use the rating tool through a procedure that (a) defined the model behind the rating scales; (b) defined the items and behavioral anchors; and (c) used videotapes of prior exercises to provide practice in using the rating scales. Ratings from each subscale were combined to create an overall score. Also, raters assessed the overall displayed adaptability of the participants on a second scale. The two criteria were significantly correlated ($r = 0.86$, $p < .05$). Because research has not yet determined the weighting of the individual adaptability facets in the prediction of overall adaptability, the research team chose to use the *overall adaptability* item as the primary criterion.

Interrater agreement on the scales was defined as ratings that did not differ by more than 2 points (Lawlis & Lu, 1972; Fleenor, Fleenor, & Grossnickle, 1996). With this criteria, raters on the overall measure agreed 89% of the time on the *overall adaptability* item. A second, more conservative, criterion was developed also that defined agreements as ratings that differed by two or fewer intervals *and* did not cross the conceptual categories of below average, moderately successful, and exceptional. With this more conservative criterion, there was 79% agreement on the *overall adaptability* item. Analyses of interrater reliability (consistency), usually expressed in terms of corrrelational indices (Fleenor et al., 1996), indicated that ratings were significantly correlated for the overall adaptability item ($r = 0.47$, $p < .05$, $n = 19$).

Participants were informed of the purpose of the research and completed the three measures (metacognition, emotional intelligence, and optimism) prior to attending, or on the first day of the leadership development program. The trained observers rated each participant during and after the completion of the exercise. All participants were aware that they were being observed, that a special research project was taking place, and that individual feedback would not be given on the leader adaptability ratings collected (feedback on all assessments was a defining feature of this program, requiring special explanation about these ratings).

*Summary of Results*

Table 9 indicates the descriptive statistics and correlations for this investigation. Overall adaptability was associated with optimism ($r = 0.24$, $p < .05$), metacognitive skill ($r = 0.23$, $p < .05$), and marginally with total emotional intelligence score ($r = 0.16$, $p < .10$). A regression analysis indicated that optimism and metacognitive skill contributed unique variance to the prediction of adaptability ($\beta = .19$ and .18, respectively, $p < .05$). The contribution of emotional intelligence was not significant ($\beta = .02$, $p > .05$).

Table 9
*Descriptive Statistics and Correlations—Investigation 7*

| | | | *M* | *SD* | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|---|---|---|
| Traits | 1 | Metacognition | 4.70 | 0.76 | (.74) | | | |
| | 2 | Emotional Intelligence | 92.90 | 12.30 | .25* | (.80) | | |
| | 3 | Optimism | 3.90 | 0.49 | .23* | .51* | (.77) | |
| Criteria | 4 | Adaptability Facets | 4.00 | 1.40 | .17* | .06 | .17* | (.93) |
| | 5 | Overall Adaptability Item | 4.30 | 1.50 | .23* | .16† | .24* | .86* |

*Note.* *****$p < 0.05$, †$p < 0.10$. Reliabilities for the measures are indicated in parentheses.

The sample was separated into four groups to test the main hypothesis that participants possessing moderate to high levels of each attribute would exhibit more adaptability than those low in any one (see Smith & Foti, 1998). Group 1 contained those individuals who were above the mean on the measures optimism, metacognition, and emotional intelligence, respectively (HHH). Group 2 consisted of individuals who were above the mean on two out of the three traits (2H1L). Group 3 included those individuals below the mean on two of the three attributes (1H2L). Group 4 contained individuals who scored below the mean on each attribute (LLL). Table 10 indicates the means and standards for each group on the attributes and on overall adaptability.

Table 10
*Means and Standard Deviations for Each Pattern Group*

| | | Optimism | | Metacognitive Skill | | Emotional Intelligence | | Overall Adaptability | |
|---|---|---|---|---|---|---|---|---|---|
| Pattern | *N* | *M* | *SD* | *M* | *SD* | *M* | *SD* | *M* | *SD* |
| HHH | 21 | 4.21 | .36 | 5.42 | .45 | 103.81 | 8.90 | 5.33 | 1.24 |
| 2H1L | 33 | 4.03 | .33 | 4.80 | .60 | 97.79 | 10.23 | 4.60 | 1.64 |
| 1H2L | 31 | 3.57 | .52 | 4.54 | .64 | 86.97 | 9.19 | 4.19 | 1.42 |
| LLL | 17 | 3.37 | .29 | 3.91 | .60 | 80.41 | 7.51 | 3.88 | 1.54 |

A one-way analysis of variance (ANOVA) with a priori planned comparisons was completed on the mean ratings for adaptability. Although the focus is on the planned comparisons, the overall test indicated significant differences among the means ($F(3, 98) = 3.70$, $p < .05$). The planned comparisons indicated that individuals high in optimism, metacognition, and extroversion were rated significantly higher in adaptability than individuals either in the 1H2L group ($t(50) = 2.981$, $p < .01$) or those low on all three traits (LLL) ($t(36) = 3.23$, $p < .01$). Individuals in the 2H1L group were not significantly different from any of the other groups at the $p < .05$ level of significance; however, this group received marginally lower ratings than the HHH group ($p < .09$). In sum, the HHH group exhibited marginally greater adaptability than the 2H1L group and significantly greater adaptability than the 1H2L and LLL groups. Moreover,

participants in groups scoring moderate to low on any one or more of the attributes were not significantly different from one another in their display of adaptability.

*Discussion*

The results of this research provide evidence for the validity of optimism and meta-cognitive skills as predictors of leader adaptability. While a limited amount of research has linked optimism explicitly to leader effectiveness (e.g., Chemers, Watson, & May, 2000), this attribute has been widely associated with the management of change. Optimists are more likely to cope effectively with the stress of change (Chang, 2001). More specifically, optimists tend to use adaptive coping efforts—such as problem solving and seeking social support—whereas pessimists tend to use maladaptive techniques such as problem avoidance and social withdrawal (Scheier & Carver, 1985; Carver & Scheier, 2001). Accordingly, optimists are likely to be more motivated and energized by change events and therefore more likely to succeed.

The significant effects of metacognitive skills on adaptability found in this investigation add to the findings on metacognition from the other investigations in this research effort. Adaptation was defined earlier as a complex problem solving process involving high level reasoning and divergent thinking skills. Metacognitive skills help to regulate and monitor such cognitive activities in three ways (Davidson et al., 1994). First, they help individuals to understand a problem and its parameters. Second, they promote the search for effective solutions. Finally, they help to monitor the solution once it has been implemented and adapt it to changing conditions. Thus, such skills facilitate the complex cognitive processes necessary for leaders to adapt to dynamic circumstances.

The pattern trait hypothesis received limited support. Leaders who exhibited high scores on two of the attributes did not yield significantly different adaptability ratings from their counterparts who exhibited low scores on two or all three of the adaptability traits. Leaders scoring high on all three attributes were only marginally superior in adaptability from the HHL leaders. One constraining element in this data set, though, is the relatively slight influence of emotional intelligence on adaptability. This lack of an effect attenuates potential differences between the HHH and HHL. A more robust test of the pattern trait hypothesis would require three strong candidate attributes.

*Research Products*

Bader, P. K., Zaccaro, S. J., & Kemp, C. F. (2004). *Predicting leader adaptability with leader trait patterns.* Paper presented at the 19th annual meeting of the Society for Industrial and Organizational Psychology, April 2004, Chicago, IL.

### *Investigation 8: Predicting Leader Adaptability With Leader Trait Patterns–2*

#### *Overview and Hypotheses*

The purpose of this investigation was the same as that of Investigation 7: to examine the relationships between cognitive, social, and dispositional leader attributes and adaptive performance. The sample in this project contained USAF mid-level officers enrolled in a leadership development course. In this research, social intelligence replaced emotional intelligence as a candidate social attribute. Also, the candidate dispositional variables included tolerance for ambiguity and openness as well as optimism. The hypotheses tested stated that (a) each leader attribute would be significantly related to leader adaptability, (b) leaders high on all three attributes would be rated significantly higher than leaders who exhibited low scores on one or more of the attributes; however (c) leaders scoring high on two of the three attributes would be no more adaptive than leaders scoring low on two or all three of the attributes.

#### *Method*

*Participants*. Participants in this research were 572 students enrolled in a USAF military leadership course. Students included 385 Air Force, 81 international, 43 Army, 35 Navy, 19 civilian, and 9 Marine Corps officers.

During the course, participants completed the assessment battery and, several weeks later, engaged in a multiplayer role-play military exercise. This exercise was conducted over three consecutive half-day class sessions. Students simulated members of a joint agency organization designed to respond quickly to emerging threats. They were expected to develop strategic and operational plans and make key decisions during the course of the exercise. They received information and "live" updates through news videos and information fed to their personal computers. Because many events indicated changes in environmental contingencies that required the students to change past strategies and develop new ones, the role-play exercise was considered appropriate for assessing adaptability.

*Measures*. Metacognition was measured using the same subscale from the Motivated Strategies for Learning Questionnaire used in the previous studies in this effort. Social intelligence was measured using a scale from Zaccaro, Zazanis, et al. (1995). Tolerance for ambiguity was measured using the MSTAT-1 (McLain, 1993). Optimism was measured using the revised version of the Life Orientation Test (LOT-R; Scheier, Carver, & Bridges, 2001). Openness was measured using 8 items from Saucier (1994).

Six behaviorally anchored rating scales (BARS) were developed to measure adaptability processes and overall adaptability. These scales were similar to the ones used in Investigation 7, but adapted to the present simulation. Students were rated on each of the six items by their course instructor at the conclusion of the 3-day exercise. Prior to completing the ratings, all raters completed a rigorous and comprehensive training session, similar to the one for Investigation 7, to promote reliability in ratings. This session consisted of (a) a definition of the model behind the rating scales; (b) definitions of the items and behavioral anchors; and (c) several practice rounds using videotapes of prior exercises. After each round of ratings,

instructors discussed and reached a consensus concerning differences in ratings. By the third practice rating, instructors were consistently identifying high, average, and low behaviors.

*Summary of Results*

A factor analysis of the BARS measure indicated that the five items assessing adaptability processes loaded on a single factor. Accordingly, these ratings were combined in a single index of adaptability. Analyses were conducted using both this average measure and the "overall adaptability" BARS item. These analyses did not indicate any differences in findings using either measure. Accordingly, the results summarized here are those from analyses using the average score across the five items.

Table 11 indicates the descriptive statistics for this investigation. Three of the five leader attributes—social intelligence, optimism, and tolerance for ambiguity—were significantly and positively correlated with adaptability. Metacognitive skills exhibited an unexpected negative correlation with adaptability ratings.

Table 11
*Descriptive Statistics and Correlations—Investigation 8*

| | *M* | *SD* | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|
| 1. Metacognition | 3.32 | .51 | (.79) | | | | |
| 2. Social intelligence | 3.57 | .35 | .31** | (.88) | | | |
| 3. Optimism | 3.85 | .52 | .18** | .47** | (.77) | | |
| 4. Tolerance for ambiguity | 3.55 | .46 | .30** | .58** | .39** | (.88) | |
| 5. Openness | 3.79 | .60 | .32** | .41** | .13** | .48** | (.81) |
| 6. Adaptability | 4.95 | .94 | -.10* | .11* | .15** | .12** | .04 |

*Note.* *$p < .05$; **$p < .01$. Reliabilities for the measures are indicated in parentheses.

Trait pattern categories (HHH, 2H1L, 1H2L, and LLL) were constructed using the same procedures used in Investigation 7, and a one-way ANOVA with planned comparisons was used to evaluate the hypothesis that (a) leaders high on all three attributes will be rated significantly higher than leaders who exhibit low scores on one or more of the attributes, while (b) leaders scoring high on two of the three attributes will be no more adaptive than leaders scoring low on two or all three of the attributes. These analyses were completed for the patterns combining metacognitive skill and social intelligence with optimism, tolerance for ambiguity, and openness, respectively. This analysis for optimism indicated that the HHH group had higher adaptability ratings ($M = 5.13$, $SD = .90$) than other groups ($M = 4.89$, $SD = .95$), $F(1, 557) = 7.4$, $p < .01$, and there were no significant differences between non-HHH groups, $F(2, 412) = 1.23$, $p > .05$. For tolerance, the HHH group had higher ratings ($M = 5.1$, $SD = .90$) than other groups ($M = 4.9$, $SD = .94$), $F(1, 577) = 4.299$, $p < .05$, and there were no significant differences between non-HHH groups, $F(2, 414) = .948$, $p > .05$. However, this pattern was not confirmed for openness: The HHH groups did not receive higher rating than other groups [$F(1, 557) = .62$, $p > .05$).

The results of these analyses need to be treated with suspicion because of the low but statistically significant negative correlation between metacognition and adaptability. One possibility of such a finding may be that in this fast-paced 3-day exercise, the display of high metacognitive skills may have appeared as too much rumination and decision procrastination to observers. In Investigation 7, such thoughtfulness and reflection was actually encouraged during the leader development course and simulation. Interviews with raters in the present investigation suggested that such activities were not perceived as positively. According, metacognitive skills may exhibit a curvilinear relationship with ratings of adaptability, where too little and too much reflection may be perceived detrimentally, but moderate amounts would be more appropriate for rated adaptability.

A multiple regression analysis was performed on metacognitive scores and adaptability to test this possible explanation. The results indeed indicated a marginal quadratic relationship ($F$-change = 3.432, $p$ = .064). Although quadratic relationships typically result in near-zero correlation, rather than negative ones, range restriction possibly contributed to this relationship. The distribution of metacognitive scores was negatively skewed (students consistently scored higher than the mean on our scale). Further investigation revealed that only 5% (n = 29) of the students scored 2.5 or less on the 5-point scale, and that the correlation between metacognition and adaptability became positive ($r$ = .26) for these students. Therefore, another reasonable conclusion from these observations is that the negative relationship between metacognition and adaptability was due to the joint effects of a curvilinear relationship and range restriction.

*Discussion*

This research, like the previous investigation, indicated modest support for the pattern-attribute approach to leader characteristics and adaptability. The combination of high cognitive and social skills with two of the three dispositional variables was significantly different from the other three patterns, and the latter combinations did not differ significantly from one another. However, the cognitive component—metacognitive skills—displayed a marginally curvilinear relationship with adaptability. The pattern attribute hypothesis reflects a threshold approach to leader effectiveness, in which a minimally acceptable level of each attribute must be possessed by the leader in order for him or her to be adaptive and effective in dynamic environments. Accordingly, it is a difficult hypothesis to assess because sufficient range must exist on all variables, the HHH combination must result in significantly higher adaptability than all other combinations of attributes, and all other combinations must not differ from one another. Investigations 7 and 8 provided small but consistent support for this pattern of findings. Future research will need to explore the interrelationships among cognitive, social, and dispositional attributes in more detail.

Investigation 8 adds to the existing literature in leadership by providing support for a set of leader skills and attributes as contributing to leader adaptability. Few, if any, prior studies have explicitly examined leader adaptability and the *combinations* of leader personal qualities that promote adaptive performance. The primary contribution of this research is that it highlights the importance of viewing leadership performance, particularly in dynamic contexts, from a multivariate perspective (Zaccaro et al., 2004). Previous trait theories of leadership attempted to predict leader behaviors and outcomes by looking at the contributions of single traits, or the

additive combinations of several traits. Current leadership models (e.g., Zaccaro, 2001; Zaccaro et al., 2004) suggest that traits function interactively. Thus, research must move beyond looking at bivariate correlations, and investigate the combined influence of trait patterns.

*Research Products*

Kemp, C. F., Zaccaro, S. J., Jordan, M., & Flippo, S., (2004*). Cognitive, social, and dispositional influences on leader adaptability*. Paper presented at the 19th annual meeting of the Society for Industrial and Organizational Psychology, Chicago, IL.

## General Summary

Zaccaro (2001) argued that research efforts on leadership should focus on five sets of leadership constructs, and should provide evidence for the validated linkages among the variables across these sets. The leadership construct sets were: (a) the nature of leadership performance, (b) the leadership processes contributing to performance, (c) the attributes and characteristics of leaders that promote the effective display of leadership processes, (d) leader training and development principles that foster growth in these attributes and characteristics, and (e) assessment and selection strategies based on these attributes. The research investigations completed in this effort provide data and results pertinent to each of these construct sets.

The nature of adaptive performance was defined at the onset as *functional change (cognitive, behavioral, and/or affective) in response to actual or correctly anticipated alterations in environmental contingencies* (Banks et al., 2001, p. 4). This definition distinguishes adaptive performance from other forms of leader performance. Accordingly, the parameters suggested by this definition (e.g., changes in the situation that require qualitatively different performance strategies) became the basis for operationalizing adaptive performance in the experimental settings and the basis for assessment of criteria in field settings. Thus, the findings in the research effort speak directly to the nature of leader adaptive performance and help establish an empirical foundation for understanding and developing such performance.

This research effort also specified the set of leader processes that ought to promote adaptive outcomes. These processes were grounded in a perspective that defined adaptation as a complex problem-solving process. Some data for the validation of these processes as precursors to adaptive outcomes was provided in Investigations 7 and 8, which found significant correlations between BARS ratings of these processes and ratings of overall adaptation. However, because these data came from the same source, they need to be treated with caution; future research needs to link measures of leadership processes to separate, and preferably objective, measures of adaptation.

Investigations 1 and 2 clarified the importance of feedback from the leader following performance for subsequent team adaptation. Marks et al. (2000) and Burke (1999) pointed to the importance of leader communications prior to adaptive task performance. This research effort adds post-performance communication as a tool for promoting team adaptation. The results of

these investigations provided parameters for the most effective use of feedback communication in team settings.

A number of cognitive, social, and dispositional leader attributes were identified in this report as contributing to the effective display of leader adaptability processes and performance. Across the research efforts, these attributes either exhibited direct effects on leader and team adaptation or moderated the effects of other variables on such performance. Direct influences on adaptation were exhibited by metacognitive skills (Investigation 7), social intelligence and social capabilities (Investigations 6 and 8), optimism (Investigations 7 and 8), and tolerance for ambiguity (Investigation 8). Moderation of the effects of different leadership and training interventions on adaptation were exhibited by metacognitive skills (Investigations 1, 4, and 5), cognitive complexity (Investigations 4 and 5), tolerance for ambiguity (Investigations 4 and 5), and learning goal orientation (Investigation 6). Note that these attributes reflect cognitive, social, and dispositional attributes of the leader, providing evidence for the efficacy of each proposed construct set of leader characteristics in predicting adaptation processes and performance. Furthermore, Investigations 7 and 8 provided some limited evidence for the premise that some of these attributes work jointly to influence adaptation, or they may display nonlinear relationships with such performance. These findings enhance the current literature on leader characteristics and performance. However, additional research is needed to explicitly test and validate the proposed links between a broader range of attributes that form the proposed construct sets and both adaptation processes and performance. Of particular interest would be the degree to which adaptive leadership processes fully mediate the effects of leader attributes on adaptive outcomes.

This research effort also examined the efficacy of several training and development principles for growing adaptability skills. The results of Investigations 1 through 3 (plus the extended pilot effort for Investigation 3) provided substantial evidence for feedback as a team leadership and training tool for facilitating team adaptation. Investigation 2 found evidence that the effects of feedback on adaptation were mediated by its effects on team mental models (see also the extended exploratory investigation completed as a follow-up to Investigation 3). Investigation 3 examined the utility of performance scenario variability in training designs to promote team adaptation. While the findings of this investigation provided only modest evidence for such utility, they were significant enough to encourage additional, more fine-grained research on how this parameter of training can best foster growth in leader and team adaptability attributes.

Investigations 4, 5, and 6 provided convincing evidence for the importance of challenging assignments in promoting growth in adaptability attributes. These investigations also demonstrated the individual qualities that enhance the value of these assignments. Furthermore, Investigation 6 linked challenging assignments in a proposed causal chain, where proximal consequences of these experiences in turn exhibited effects on adaptation, moderated by the climate of the organization. The U.S. Army has relied on operational assignments as one of its pillars of leader development. However, little research has examined how such assignments, particularly those that provide considerable developmental challenge to the job incumbents, operate as learning vehicles. The present research provides the beginning of an explanation for the perceived positive role of operational assignments.

Leader adaptability and effectiveness in unconventional and rapidly changing battlefield conditions has become a paramount concern for the U.S. Army. Such concern has translated to a need for more in-depth and comprehensive investigations of the leadership variables and processes that facilitate adaptation, and the best means of developing these variables. The research effort described in this report provides findings that touch on several key issues in leadership and adaptability. These findings should serve as one foundation for future research on these issues.

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# APPENDIX A:
# Summary of Analyses from Investigation 4

Table A-1

*Results of Moderated Regression Analyses: Interaction of Metacognition and Work Experience Variables on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .017 | .017 | | | 1.236 | .294 |
| | Metacognition | | | .136 | .136 | | .119 |
| | Work Experience | | | -.054 | -.029 | | .738 |
| Step 2: | Metacognition x Work Experience | .018 | .001 | .157 | .211 | .099 | .753 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .017 | .017 | | | 1.215 | .300 |
| | Metacognition | | | .135 | .136 | | .124 |
| | Diversity of Work Experience 1 | | | -.007 | -.024 | | .787 |
| Step 2: | Metacognition x Diversity of Work Experience 1 | .018 | .001 | -.008 | -.152 | .199 | .656 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .017 | .017 | | | 1.245 | .291 |
| | Metacognition | | | .119 | .120 | | .170 |
| | Diversity of Work Experience 2 | | | .013 | .032 | | .716 |
| Step 2: | Metacognition x Diversity of Work Experience 2 | .017 | .000 | -.002 | -.024 | .002 | .963 |

Table A-2

*Results of Moderated Regression Analyses: Interaction of Cognitive Complexity and Work Experience Variables on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .001 | .001 | | | .059 | .942 |
| | Cognitive Complexity | | | -.030 | -.025 | | .781 |
| | Work Experience | | | .048 | .026 | | .773 |
| Step 2: | Cognitive Complexity x Work Experience | .031 | .030 | .389 | 1.612 | 4.360 | .039* |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .001 | .001 | | | .064 | .938 |
| | Cognitive Complexity | | | -.031 | -.026 | | .775 |
| | Diversity of Work Experience 1 | | | .009 | .028 | | .760 |
| Step 2: | Cognitive Complexity x Diversity of Work Experience 1 | .013 | .012 | .047 | .824 | 1.686 | .196 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .006 | .006 | | | .409 | .665 |
| | Cognitive Complexity | | | -.048 | -.041 | | .643 |
| | Diversity of Work Experience 2 | | | .032 | .079 | | .378 |
| Step 2: | Cognitive Complexity x Diversity of Work Experience 2 | .021 | .015 | .069 | .922 | 2.095 | .150 |

*Note.* $*p < .05$.

Table A-3

*Results of Moderated Regression Analyses: Interaction of Metacognition Subscale and Work Experience Variables on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .004 | .004 | | | .260 | .771 |
| | Metacognition Subscale | | | -.058 | -.063 | | .490 |
| | Work Experience | | | .073 | .040 | | .663 |
| Step 2: | Metacognition x Work Experience | .034 | .031 | .324 | 1.546 | 4.429 | .037* |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .004 | .004 | | | .276 | .759 |
| | Metacognition Subscale | | | -.060 | -.065 | | .479 |
| | Diversity of Work Experience 1 | | | .014 | .043 | | .638 |
| Step 2: | Metacognition x Diversity of Work Experience 1 | .015 | .011 | .036 | .697 | 1.554 | .215 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .010 | .010 | | | .697 | .500 |
| | Metacognition Subscale | | | -.073 | -.079 | | .376 |
| | Diversity of Work Experience 2 | | | .037 | .092 | | .304 |
| Step 2: | Metacognition x Diversity of Work Experience 2 | .016 | .007 | .039 | .570 | .934 | .336 |

*Note.* $*p < .05$.

Table A-4

*Results of Moderated Regression Analyses: Interaction of Tolerance for Ambiguity and Work Experience Variables on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .007 | .007 | | | .482 | .619 |
| | Tolerance for Ambiguity | | | -.096 | -.087 | | .331 |
| | Work Experience | | | .073 | .040 | | .657 |
| Step 2: | Tolerance for Ambiguity x Work Experience | .008 | .001 | | | .155 | .695 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .007 | .007 | | | .495 | .610 |
| | Tolerance for Ambiguity | | | -.096 | -.089 | | .323 |
| | Diversity of Work Experience 1 | | | .012 | .039 | | .661 |
| Step 2: | Tolerance for Ambiguity x Diversity of Work Experience 1 | .028 | .021 | -.057 | -1.019 | 3.115 | .080† |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .011 | .011 | | | .829 | .438 |
| | Tolerance for Ambiguity | | | -.103 | -.095 | | .271 |
| | Diversity of Work Experience 2 | | | .032 | .080 | | .356 |
| Step 2: | Tolerance for Ambiguity x Diversity of Work Experience 2 | .019 | .008 | -.046 | -.616 | .935 | .426 |

*Note.* †$p < 0.10$.

Table A-5

*Results of Moderated Regression Analyses: Interaction of Openness to Experience and Work Experience Variables on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .001 | .001 | | | .080 | .923 |
| | Openness to Experience | | | .029 | .034 | | .701 |
| | Work Experience | | | -.052 | -.003 | | .975 |
| Step 2: | Openness to Experience x Work Experience | .020 | .019 | .207 | 1.167 | 2.769 | .098 † |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .001 | .001 | | | .075 | .928 |
| | Openness to Experience | | | .028 | .034 | | .705 |
| | Diversity of Work Experience 1 | | | -.001 | -.004 | | .960 |
| Step 2: | Openness to Experience x Diversity of Work Experience 1 | .002 | .001 | .009 | .207 | .131 | .718 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .003 | .003 | | | .241 | .786 |
| | Openness to Experience | | | .016 | .019 | | .825 |
| | Diversity of Work Experience 2 | | | .020 | .050 | | .564 |
| Step 2: | Openness to Experience x Diversity of Work Experience 2 | .009 | .006 | .030 | .559 | .862 | .355 |

*Note.* $^{\dagger}p < 0.10$.

Table A-6

*Results of Moderated Regression Analyses: Interaction of Metacognition and Work Experience Variables on Social Competencies*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .241 | .241 | | | 22.833 | .000*** |
| | Metacognition | | | .383 | .398 | | .000*** |
| | Work Experience | | | .246 | .195 | | .011* |
| Step 2: | Metacognition x Work Experience | .241 | .001 | | | .115 | .735 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .256 | .256 | | | 24.397 | .000*** |
| | Metacognition | | | .398 | .410 | | .000*** |
| | Diversity of Work Experience 1 | | | .061 | .199 | | .010* |
| Step 2: | Metacognition x Diversity of Work Experience 1 | .350 | .095 | .063 | 1.250 | 20.556 | .000*** |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .256 | .256 | | | 24.582 | .000*** |
| | Metacognition | | | .405 | .416 | | .000*** |
| | Diversity of Work Experience 2 | | | .078 | .195 | | .010* |
| Step 2: | Metacognition x Diversity of Work Experience 2 | .292 | .036 | .079 | 1.177 | 7.300 | .008** |

*Note* .*$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Table A-7

*Results of Moderated Regression Analyses: Interaction of Cognitive Complexity and Work Experience Variables on Social Competencies*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .297 | .297 | | | 29.988 | .000*** |
| | Cognitive Complexity | | | .541 | .484 | | .000*** |
| | Work Experience | | | .230 | .129 | | .089† |
| Step 2: | Cognitive Complexity x Work Experience | .302 | .005 | .150 | .650 | .985 | .323 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .295 | .295 | | | 29.672 | .000*** |
| | Cognitive Complexity | | | .545 | .487 | | .000*** |
| | Diversity of Work Experience 1 | | | .036 | .119 | | .118 |
| Step 2: | Cognitive Complexity x Diversity of Work Experience 1 | .312 | .017 | .054 | .983 | 3.486 | .064† |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .302 | .302 | | | 30.740 | .000*** |
| | Cognitive Complexity | | | .539 | .482 | | .000*** |
| | Diversity of Work Experience 2 | | | .058 | .149 | | .047* |
| Step 2: | Cognitive Complexity x Diversity of Work Experience 2 | .302 | .000 | .005 | .064 | .014 | .904 |

*Note.* †$p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Table A-8

*Results of Moderated Regression Analyses: Interaction of Metacognition Subscale and Work Experience Variables on Social Competencies*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .241 | .241 | | | 22.503 | .000*** |
| | Metacognition Subscale | | | .280 | .157 | | .047* |
| | Work Experience | | | .364 | .410 | | .000*** |
| Step 2: | Metacognition x Work Experience | .267 | .027 | .291 | 1.449 | 5.130 | .025* |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .236 | .236 | | | 21.906 | .000*** |
| | Metacognition Subscale | | | .042 | .139 | | .082† |
| | Diversity of Work Experience 1 | | | .367 | .414 | | .000*** |
| Step 2: | Metacognition x Diversity of Work Experience 1 | .288 | .052 | .076 | 1.521 | 10.348 | .002** |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .244 | .244 | | | 22.917 | .000*** |
| | Metacognition Subscale | | | .065 | .168 | | .033* |
| | Diversity of Work Experience 2 | | | .364 | .411 | | .000*** |
| Step 2: | Metacognition x Diversity of Work Experience 2 | .257 | .013 | .052 | .787 | 2.377 | .125 |

*Note.* †$p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

Table A-9

*Results of Moderated Regression Analyses: Interaction of Tolerance for Ambiguity and Work Experience Variables on Social Competencies*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .182 | .182 | | | 16.170 | .000*** |
| | Tolerance for Ambiguity | | | .330 | .314 | | .000*** |
| | Work Experience | | | .358 | .201 | | .013* |
| Step 2: | Tolerance for Ambiguity x Work Experience | .187 | .005 | -.142 | -.622 | .888 | .347 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .197 | .197 | | | 17.856 | .000*** |
| | Tolerance for Ambiguity | | | .348 | .329 | | .000*** |
| | Diversity of Work Experience 1 | | | .061 | .200 | | .013* |
| Step 2: | Tolerance for Ambiguity x Diversity of Work Experience 1 | .199 | .002 | -.018 | -.331 | .406 | .525 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .208 | .208 | | | 19.120 | .000*** |
| | Tolerance for Ambiguity | | | .367 | .347 | | .000*** |
| | Diversity of Work Experience 2 | | | .087 | .221 | | .004** |
| Step 2: | Tolerance for Ambiguity x Diversity of Work Experience 2 | .229 | .022 | -.074 | -1.016 | 4.089 | .045* |

*Note.* **p* < 0.05. ***p* < 0.01. ****p* < 0.001.

Table A-10

*Results of Moderated Regression Analyses: Interaction of Openness to Experience and Work Experience Variables on Social Competencies*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Total Challenging Assignments | | | | | | | |
| Step 1: | Main Effects | .178 | .178 | | | 15.720 | .000*** |
| | Openness to Experience | | | .245 | .064 | | .000*** |
| | Work Experience | | | .360 | .203 | | .013* |
| Step 2: | Openness to Experience x Work Experience | .185 | .007 | .118 | .690 | 1.174 | .280 |
| Diversity of Work Experience 1 | | | | | | | |
| Step 1: | Main Effects | .190 | .190 | | | 17.163 | .000*** |
| | Openness to Experience | | | .255 | .314 | | .000*** |
| | Diversity of Work Experience 1 | | | .066 | .217 | | .007** |
| Step 2: | Openness to Experience x Diversity of Work Experience 1 | .195 | .195 | .020 | .487 | .914 | .341 |
| Diversity of Work Experience 2 | | | | | | | |
| Step 1: | Main Effects | .195 | .195 | | | 17.685 | .000*** |
| | Openness to Experience | | | .266 | .328 | | .000*** |
| | Diversity of Work Experience 2 | | | .088 | .223 | | .004** |
| Step 2: | Openness to Experience x Diversity of Work Experience 2 | .195 | .000 | -.004 | -.075 | .019 | .890 |

*Note.* *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

APPENDIX B:
Summary of Analyses from Investigation 5

Table B-1

*Results of Hierarchical Regression Analyses: Effects of Socially Complex and Informationally Complex Work Experience Categories on Cognitive Attributes*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Metacognition | | | | | | | |
| Step 1: | | .173 | .173 | | | 12.588 | .001** |
| | Socially Complex Work Experiences | | | .398 | .416 | | .001** |
| Step 2: | | .179 | .006 | | | 6.429 | .003** |
| | Socially Complex Work Experiences | | | .270 | .283 | | .248 |
| | Informationally Complex Work Experiences | | | .135 | .153 | | .531 |
| Cognitive Complexity | | | | | | | |
| Step 1: | | .108 | .108 | | | 7.506 | .008** |
| | Socially Complex Work Experiences | | | .309 | .329 | | .008** |
| Step 2: | | .109 | .001 | | | 3.740 | .029* |
| | Socially Complex Work Experiences | | | .248 | .264 | | .304 |
| | Informationally Complex Work Experiences | | | .064 | .074 | | .772 |

*Note.* *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

Table B-2

*Results of Hierarchical Regression Analyses: Effects of Informationally Complex and Socially Complex Work Experience Categories on Social Attributes*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Social Intelligence | | | | | | | |
| Step 1: | | .236 | .236 | | | 18.236 | .000*** |
| | Informationally Complex Work Experiences | | | .320 | .486 | | .000*** |
| Step 2: | | .291 | .055 | | | 11.886 | .000*** |
| | Informationally Complex Work Experiences | | | .043 | .065 | | .778 |
| | Socially Complex Work Experiences | | | .340 | .482 | | .039* |
| Self-Monitoring | | | | | | | |
| Step 1: | | .240 | .240 | | | 18.999 | .000*** |
| | Informationally Complex Work Experiences | | | .551 | .490 | | .000*** |
| Step 2: | | .285 | .045 | | | 11.762 | .000*** |
| | Informationally Complex Work Experiences | | | .114 | .102 | | .661 |
| | Socially Complex Work Experiences | | | .536 | .442 | | .060† |
| Communicative Competence | | | | | | | |
| Step 1: | | .050 | .050 | | | 3.132 | .082† |
| | Informationally Complex Work Experiences | | | .136 | .223 | | .082† |
| Step 2: | | .078 | .029 | | | 2.511 | .090† |
| | Informationally Complex Work Experiences | | | -.055 | -.090 | | .732 |
| | Socially Complex Work Experiences | | | .235 | .356 | | .179 |

*Note.* †$p < 0.10$. *$p < 0.05$. **$p < 0.01$. ***$p < 0.001$

Table B-3

*Results of Moderated Regression Analyses: Interaction of Cognitive Attributes and Work Experiences on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Unfamiliar Responsibilities | | | | | | | |
| Step 1: | Main Effects | .022 | .022 | | | .413 | .745 |
| | Unfamiliar Responsibilities | | | .021 | .080 | | .560 |
| | Metacognition | | | -.031 | -.101 | | .530 |
| | Cognitive Complexity | | | -.017 | -.056 | | .734 |
| Step 2: | Interactions | .064 | .042 | | | .721 | .610 |
| | Metacognition x Unfamiliar Responsibilities | | | .014 | .227 | | .884 |
| | Cognitive Complexity x Unfamiliar Responsibilities | | | -.167 | -2.946 | | .192 |
| New Directions | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .302 | .824 |
| | New Directions | | | -.003 | -.019 | | .897 |
| | Metacognition | | | -.029 | -.098 | | .555 |
| | Cognitive Complexity | | | -.009 | -.032 | | .846 |
| Step 2: | Interactions | .030 | .014 | | | .327 | .895 |
| | Metacognition x New Directions | | | -.008 | -.207 | | .907 |
| | Cognitive Complexity x New Directions | | | .054 | 1.381 | | .435 |
| Inherited Problems | | | | | | | |
| Step 1: | Main Effects | .024 | .024 | | | .451 | .718 |
| | Inherited Problems | | | .019 | .092 | | .502 |
| | Metacognition | | | -.038 | -.124 | | .451 |
| | Cognitive Complexity | | | -.009 | -.030 | | .854 |
| Step 2: | Interactions | .030 | .006 | | | .325 | .896 |
| | Metacognition x Inherited Problems | | | -.042 | -.814 | | .609 |
| | Cognitive Complexity x Inherited Problems | | | .039 | .724 | | .653 |
| Problems with Employees | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .297 | .827 |
| | Problems with Employees | | | -.002 | -.007 | | .961 |
| | Metacognition | | | -.031 | -.101 | | .539 |
| | Cognitive Complexity | | | -.011 | -.036 | | .822 |
| Step 2: | Interactions | .018 | .002 | | | .190 | .965 |
| | Metacognition x Problems with Employees | | | .010 | .153 | | .935 |
| | Cognitive Complexity x Problems with Employees | | | .021 | .312 | | .859 |

Table B-3 (Continued)

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| High Stakes | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .304 | .822 |
| | High Stakes | | | -.004 | -.023 | | .879 |
| | Metacognition | | | -.028 | -.093 | | .594 |
| | Cognitive Complexity | | | -.011 | -.035 | | .826 |
| Step 2: | Interactions | .021 | .005 | | | .231 | .947 |
| | Metacognition x High Stakes | | | .003 | .081 | | .968 |
| | Cognitive Complexity x High Stakes | | | .034 | .833 | | .717 |
| Scope and Scale | | | | | | | |
| Step 1: | Main Effects | .020 | .020 | | | .384 | .765 |
| | Scope and Scale | | | -.015 | -.074 | | .613 |
| | Metacognition | | | -.023 | -.075 | | .660 |
| | Cognitive Complexity | | | -.009 | -.033 | | .837 |
| Step 2: | Interactions | .055 | .034 | | | .615 | .689 |
| | Metacognition x Scope and Scale | | | .099 | 2.249 | | .230 |
| | Cognitive Complexity x Scope and Scale | | | -.016 | -.361 | | .874 |
| External Pressure | | | | | | | |
| Step 1: | Main Effects | .038 | .038 | | | .731 | .538 |
| | External Pressure | | | .026 | .163 | | .262 |
| | Metacognition | | | -.046 | -.151 | | .363 |
| | Cognitive Complexity | | | -.017 | -.058 | | .720 |
| Step 2: | Interactions | .045 | .007 | | | .504 | .772 |
| | Metacognition x External Pressure | | | -.036 | -.970 | | .557 |
| | Cognitive Complexity x External Pressure | | | .043 | 1.189 | | .559 |
| Influence Without Authority | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .296 | .828 |
| | Influence Without Authority | | | -.001 | -.003 | | .984 |
| | Metacognition | | | -.031 | -.101 | | .544 |
| | Cognitive Complexity | | | -.011 | -.036 | | .828 |
| Step 2: | Interactions | .037 | .022 | | | .413 | .838 |
| | Metacognition x Influence Without Authority | | | -.063 | -1.532 | | .392 |
| | Cognitive Complexity x Influence Without Authority | | | .101 | 2.572 | | .282 |

Table B-3 (Continued)

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Work Across Cultures | | | | | | | |
| Step 1: | Main Effects | .017 | .017 | | | .326 | .807 |
| | Work Across Cultures | | | -.008 | -.041 | | .770 |
| | Metacognition | | | -.028 | -.094 | | .569 |
| | Cognitive Complexity | | | -.010 | -.034 | | .833 |
| Step 2: | Interactions | .041 | .024 | | | .453 | .809 |
| | Metacognition x Work Across Cultures | | | -.015 | -.329 | | .818 |
| | Cognitive Complexity x Work Across Cultures | | | .083 | 1.844 | | .311 |
| Work Group Diversity | | | | | | | |
| Step 1: | Main Effects | .017 | .017 | | | .325 | .807 |
| | Work Group Diversity | | | -.007 | -.041 | | .772 |
| | Metacognition | | | -.028 | -.093 | | .570 |
| | Cognitive Complexity | | | -.009 | -.030 | | .852 |
| Step 2: | Interactions | .165 | .148 | | | 2.100 | .080† |
| | Work Group Diversity | | | -.607 | -3.408 | | .003** |
| | Metacognition x Work Group Diversity | | | .089 | 2.303 | | .196 |
| | Cognitive Complexity x Work Group Diversity | | | .077 | 2.092 | | .178 |
| Total Challenging Work Experiences | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .305 | .821 |
| | Total Challenging Work Experiences | | | .007 | .025 | | .870 |
| | Metacognition | | | -.034 | -.111 | | .515 |
| | Cognitive Complexity | | | -.012 | -.040 | | .805 |
| Step 2: | Interactions | .038 | .021 | | | .417 | .835 |
| | Metacognition x Total Challenging Work Experiences | | | -.045 | -.831 | | .716 |
| | Cognitive Complexity x Total Challenging Work Experiences | | | .145 | 2.694 | | .330 |
| Breadth of Work Experiences | | | | | | | |
| Step 1: | Main Effects | .016 | .016 | | | .298 | .827 |
| | Breadth of Work Experiences | | | .001 | .010 | | .948 |
| | Metacognition | | | -.032 | -.105 | | .532 |
| | Cognitive Complexity | | | -.011 | -.038 | | .816 |
| Step 2: | Interactions | .062 | .046 | | | .697 | .628 |
| | Metacognition x Breadth of Work Experiences | | | .007 | .609 | | .395 |
| | Cognitive Complexity x Breadth of Work Experiences | | | .021 | 1.883 | | .296 |

*Note.* †$p < 0.10$. * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$

Table B-4

*Results of Moderated Regression Analyses: Interaction of Dispositional Attributes and Work Experiences on Tacit Knowledge*

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Unfamiliar Responsibilities | | | | | | | |
| Step 1: | Main Effects | .082 | .082 | | | 1.612 | .197 |
| | Unfamiliar Responsibilities | | | .053 | .198 | | .139 |
| | Tolerance of Ambiguity | | | -.067 | -.225 | | .108 |
| | Openness to Experience | | | -.004 | -.019 | | .892 |
| Step 2: | Interactions | .091 | .009 | | | 1.046 | .401 |
| | Tolerance of Ambiguity x Unfamiliar Responsibilities | | | .012 | .186 | | .902 |
| | Openness to Experience x Unfamiliar Responsibilities | | | .044 | .825 | | .600 |
| New Directions | | | | | | | |
| Step 1: | Main Effects | .054 | .054 | | | 1.026 | .389 |
| | New Directions | | | .021 | .113 | | .451 |
| | Tolerance of Ambiguity | | | -.076 | -.254 | | .098† |
| | Openness to Experience | | | -.003 | -.015 | | .918 |
| Step 2: | Interactions | .073 | .019 | | | .820 | .541 |
| | Tolerance of Ambiguity x New Directions | | | .062 | 1.621 | | .356 |
| | Openness to Experience x New Directions | | | -.052 | -1.448 | | .351 |
| Inherited Problems | | | | | | | |
| Step 1: | Main Effects | .079 | .079 | | | 1.552 | .212 |
| | Inherited Problems | | | .042 | .196 | | .154 |
| | Tolerance of Ambiguity | | | -.077 | -.260 | | .072† |
| | Openness to Experience | | | -.002 | -.008 | | .952 |
| Step 2: | Interactions | .098 | .018 | | | 1.127 | .358 |
| | Tolerance of Ambiguity x Inherited Problems | | | .015 | .306 | | .854 |
| | Openness to Experience x Inherited Problems | | | -.048 | -1.070 | | .318 |
| Problems With Employees | | | | | | | |
| Step 1: | Main Effects | .071 | .071 | | | 1.367 | .263 |
| | Problems With Employees | | | .056 | .174 | | .217 |
| | Tolerance of Ambiguity | | | -.078 | -.262 | | .075† |
| | Openness to Experience | | | -.003 | -.016 | | .909 |
| Step 2: | Interactions | .129 | .058 | | | 1.541 | .193 |
| | Tolerance of Ambiguity x Problems With Employees | | | .189 | 2.971 | | .098† |
| | Openness to Experience x Problems With Employees | | | -.078 | -1.340 | | .205 |

Table B-4 (Continued)

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| High Stakes | | | | | | | |
| Step 1: | Main Effects | .049 | .049 | | | .933 | .431 |
| | High Stakes | | | .017 | .085 | | .580 |
| | Tolerance of Ambiguity | | | -.071 | -.238 | | .115 |
| | Openness to Experience | | | -.005 | -.022 | | .879 |
| Step 2: | Interactions | .093 | .044 | | | 1.072 | .387 |
| | Tolerance of Ambiguity x High Stakes | | | .081 | 2.062 | | .165 |
| | Openness to Experience x High Stakes | | | -.066 | -1.889 | | .212 |
| Scope and Scale | | | | | | | |
| Step 1: | Main Effects | .044 | .044 | | | .826 | .485 |
| | Scope and Scale | | | .002 | .010 | | .941 |
| | Tolerance of Ambiguity | | | -.063 | -.212 | | .147 |
| | Openness to Experience | | | .000 | .000 | | .999 |
| Step 2: | Interactions | .156 | .112 | | | 1.923 | .106 |
| | Tolerance of Ambiguity | | | -.551 | -1.849 | | .010** |
| | Openness to Experience | | | .410 | 1.885 | | .044* |
| | Tolerance of Ambiguity x Scope and Scale | | | .153 | 3.467 | | .018* |
| | Openness to Experience x Scope and Scale | | | -.136 | -3.494 | | .040* |
| External Pressure | | | | | | | |
| Step 1: | Main Effects | .103 | .103 | | | 2.069 | .115 |
| | External Pressure | | | .044 | .270 | | .064† |
| | Tolerance of Ambiguity | | | -.081 | -.273 | | .056† |
| | Openness to Experience | | | -.017 | -.078 | | .586 |
| Step 2: | Interactions | .126 | .022 | | | 1.493 | .208 |
| | Tolerance of Ambiguity x External Pressure | | | .049 | 1.391 | | .306 |
| | Openness to Experience x External Pressure | | | -.035 | -1.104 | | .341 |
| Influence Without Authority | | | | | | | |
| Step 1: | Main Effects | .055 | .055 | | | 1.044 | .381 |
| | Influence Without Authority | | | .025 | .125 | | .431 |
| | Tolerance of Ambiguity | | | -.076 | -.256 | | .095† |
| | Openness to Experience | | | -.008 | -.036 | | .808 |
| Step 2: | Interactions | .092 | .037 | | | 1.058 | .395 |
| | Tolerance of Ambiguity x Influence Without Authority | | | .078 | 1.988 | | .149 |
| | Openness to Experience x Influence Without Authority | | | -.017 | -.488 | | .672 |

Table B-4 (Continued)

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Work Across Cultures | | | | | | | |
| Step 1: | Main Effects | .044 | .044 | | | .837 | .479 |
| | Work Across Cultures | | | .005 | .026 | | .848 |
| | Tolerance of Ambiguity | | | -.064 | -.214 | | .137 |
| | Openness to Experience | | | -.000 | .000 | | .998 |
| Step 2: | Interactions | .088 | .044 | | | 1.003 | .425 |
| | Tolerance of Ambiguity x Work Across Cultures | | | .041 | .915 | | .507 |
| | Openness to Experience x Work Across Cultures | | | -.080 | -1.942 | | .123 |
| Work Group Diversity | | | | | | | |
| Step 1: | Main Effects | .045 | .045 | | | .839 | .478 |
| | Work Group Diversity | | | .005 | .029 | | .837 |
| | Tolerance of Ambiguity | | | -.064 | -.216 | | .137 |
| | Openness to Experience | | | -.001 | -.002 | | .990 |
| Step 2: | Interactions | .139 | .094 | | | 1.673 | .158 |
| | Tolerance of Ambiguity | | | -.606 | -2.036 | | .012* |
| | Tolerance of Ambiguity x Work Group Diversity | | | .150 | 3.781 | | .022* |
| | Openness to Experience x Work Group Diversity | | | -.048 | -1.454 | | .303 |
| Total Challenging Work Experiences | | | | | | | |
| Step 1: | Main Effects | .072 | .072 | | | 1.394 | .255 |
| | Total Challenging Work Experiences | | | .056 | .194 | | .207 |
| | Tolerance of Ambiguity | | | -.084 | -.281 | | .064† |
| | Openness to Experience | | | -.009 | -.046 | | .750 |
| Step 2: | Interactions | .149 | .077 | | | 1.816 | .126 |
| | Tolerance of Ambiguity | | | -.589 | -1.976 | | .034* |
| | Openness to Experience | | | .415 | 1.907 | | .078† |
| | Tolerance of Ambiguity x Total Challenging Work Experiences | | | .180 | 3.488 | | .057† |
| | Openness to Experience x Total Challenging Work Experiences | | | -.159 | -3.432 | | .067† |

Table B-4 (Continued)

| | | $R^2$ | $\Delta R^2$ | b | β | *F* | *p* |
|---|---|---|---|---|---|---|---|
| Breadth of Work Experiences | | | | | | | |
| Step 1: | Main Effects | .066 | .066 | | | 1.268 | .295 |
| | Diversity of Work Experience 1 | | | .007 | .163 | | .593 |
| | Tolerance of Ambiguity | | | -.079 | -.263 | | .077† |
| | Openness to Experience | | | -.005 | -.025 | | .860 |
| Step 2: | Interactions | .176 | .110 | | | 2.225 | .066† |
| | Tolerance of Ambiguity | | | -.249 | -.834 | | .007** |
| | Tolerance of Ambiguity x Breadth of Work Experiences | | | .034 | 3.077 | | .020* |
| | Openness to Experience x Breadth of Work Experiences | | | -.025 | -2.353 | | .053† |

*Note.* †$p < 0.10$. * $p < 0.05$. **$p < 0.01$. ***$p < 0.001$.

# APPENDIX C:
# Illustrations of Interactions from Investigation 6 (adapted from Banks, 2006)

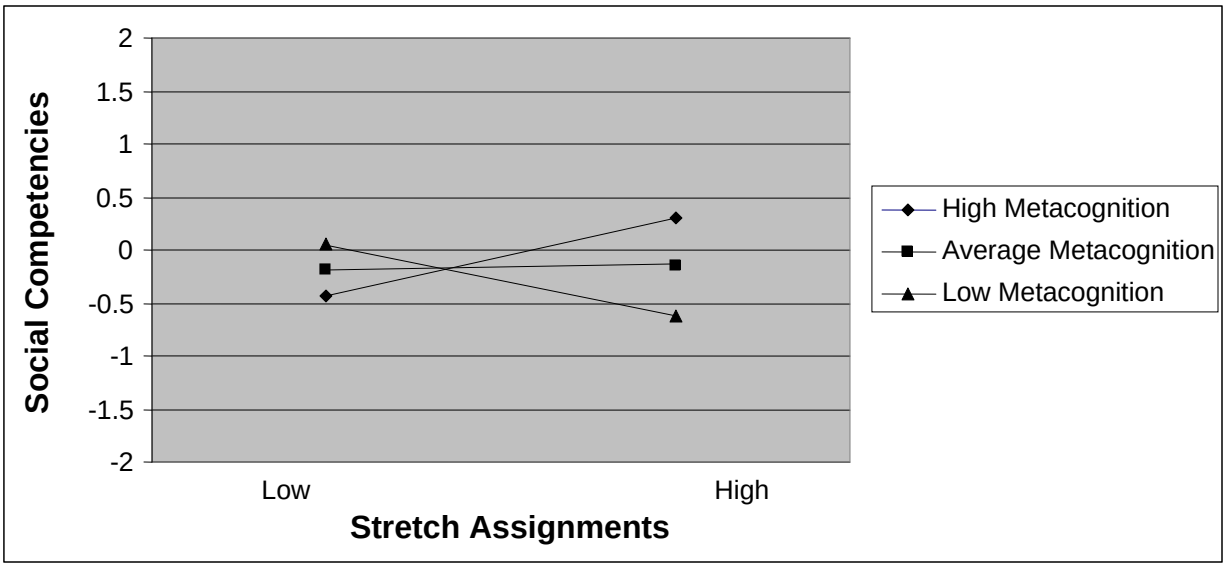


*Figure C-1.* Interaction of stretch assignments and metacognition on social competencies.

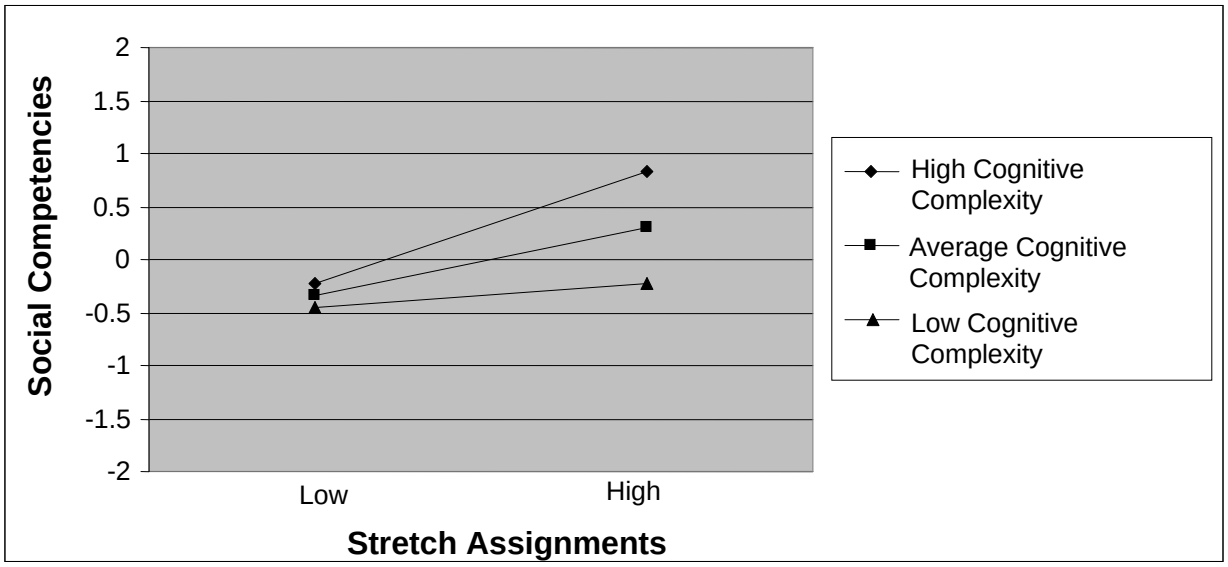


*Figure C-2.* Interaction of stretch assignments and cognitive complexity on social competencies.

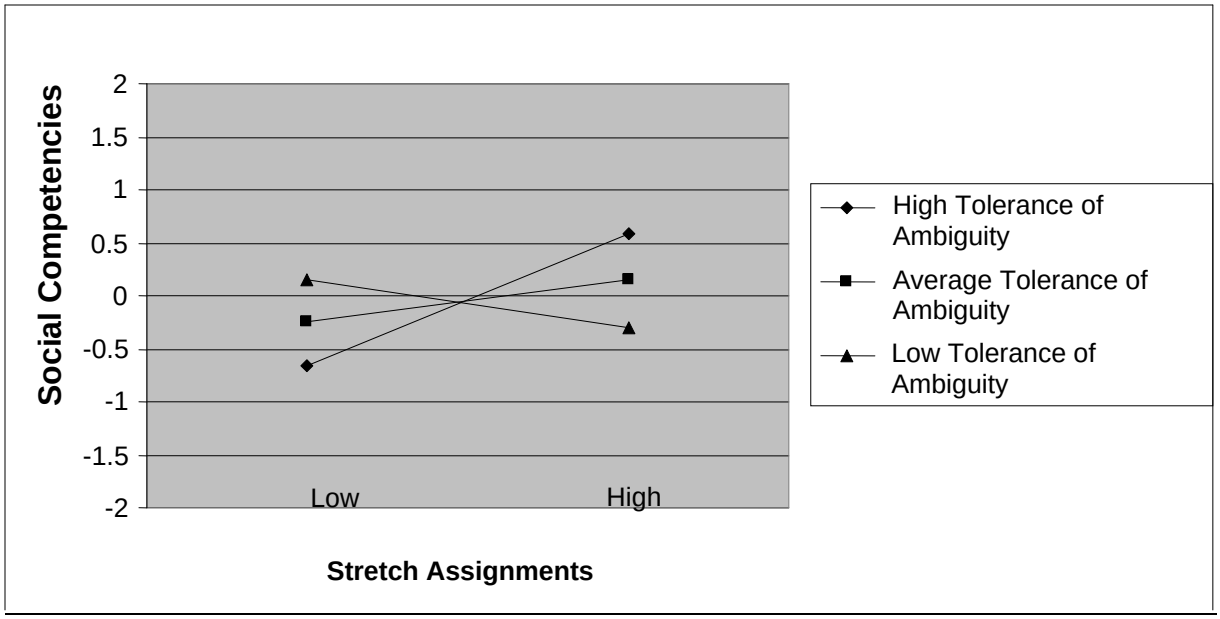


*Figure C-3*. Interaction of stretch assignments and tolerance of ambiguity on social competencies.

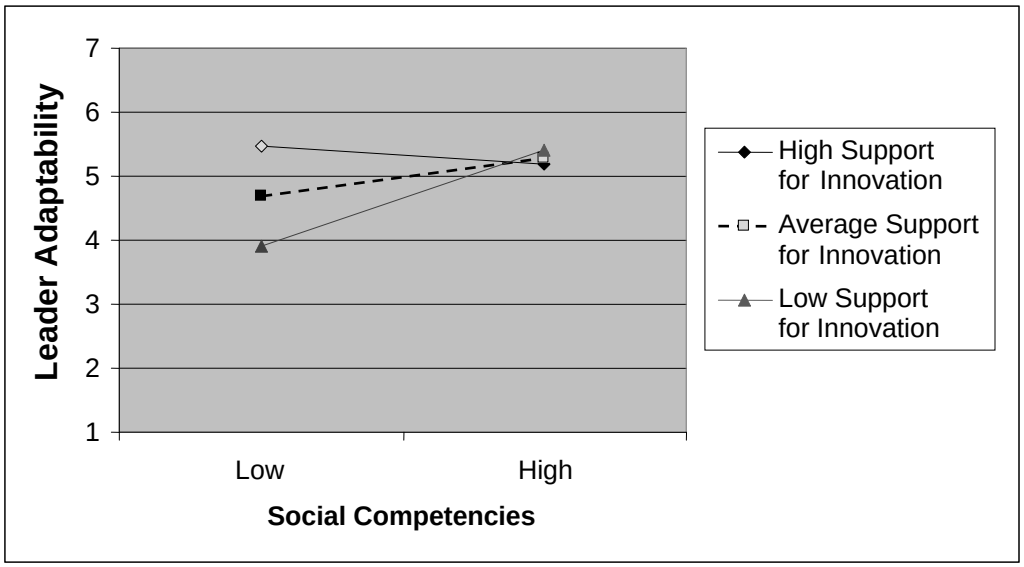


*Figure C-4.* Interaction of social competencies and support for innovation on supervisor ratings of leader adaptability.